

**Higher Education in Regional and City
Development**

State of Veracruz, Mexico



State of Veracruz, Mexico

2010

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Foreword

Universities and other higher education institutions can play a key role in human capital development and innovation systems in their cities and regions. Reviews of Higher Education in Regional and City Development are the OECD's vehicle to mobilise higher education for economic, social and cultural development of cities and regions. The reviews analyse how the higher education system impacts local and regional development and help improve this impact. They examine higher education institutions' contribution to human capital and skills development; technology transfer and business innovation; social, cultural and environmental development; and regional capacity building. The review process facilitates partnership building in regions by drawing together higher education institutions and public and private agencies to identify strategic goals and work together towards them. To know more about the OECD review process and requirements, visit Higher Education and Regions' website at: www.oecd.org/edu/imhe/regionaldevelopment.

These reviews are part of a wider multi-annum work of higher education in cities and regions co-ordinated by the OECD Programme on Institutional Management of Higher Education (IMHE). In 2004-07, the OECD/IMHE conducted an extensive study with 14 regional reviews across 12 countries. This resulted in the OECD flagship publication *Higher Education and Regions: Globally Competitive, Locally Engaged* (OECD, 2007) with recommendations to benefit both higher education institutions and national and regional governments. In 2008, the OECD/IMHE launched a second series of OECD Reviews of Higher Education in Regional and City Development to address the demand by national, regional and local governments for more responsive and active higher education institutions. As a result, 14 regions in 11 countries participated in the OECD review process in 2008-10. The reviews were carried out by the OECD/IMHE in collaboration with international organisations and associations as well as other OECD programmes and directorates. This work also supports the OECD Innovation Strategy and OECD Green Growth Strategy.

This OECD review of the State of Veracruz, Mexico is part of the second round of OECD reviews of Higher Education in Regional and City

Development, Mexico has been active participant in the review programme: the review of Veracruz follows the review of Nuevo León in 2006 and coincides with the review of Paso del Norte cross-border region in 2009-10.

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This publication draws on interviews carried out during a week-long review visit on 11-17 October 2009, on the material provided by the regional co-ordinators and using additional information provided to the review team. The OECD review team had a full and intensive programme and were received openly by a wide range of stakeholders. The team were also to rely on a range of other reports, including the OECD Thematic Reviews of Tertiary Education: Country Background Report for Mexico and the OECD Thematic Review of Tertiary Education: Country Note for Mexico, and tested their conclusions and recommendations within the higher education sector in the State of Veracruz.

The review visit to the State of Veracruz was co-ordinated by Ernesto Flores, a Mexican national seconded from Sonora Institute of Technology (ITSON) to the OECD/IMHE for a period of 15 months. Other IMHE staff – Jaana Puukka and Austin Delaney – helped to bring this review report to the final stages. The members of the OECD review team – Patrick Dubarle (former OECD Secretariat), Marco Marchese (OECD/LEED, Centre for Entrepreneurship, SMEs and Local Development), Juan Carlos Navarro (Inter-American Development Bank) and Jocelyne Gacel-Avila (University of Guadalajara, Mexico) contributed to the review report. Further details about the review team can be found in Annex I of this report. Fionnuala Canning provided invaluable assistance in the editing phase and Rachel Linden supervised the publication process.

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List of Acronyms

AIEVAC	<i>Asociación de Industriales del Estado de Veracruz</i> Association of Industries of the State of Veracruz
BDS	Business Development Services
CIBEI	Centro de Investigaciones Biomédicas sobre Enfermedades Infecciosas Biomedical Research Centre for Infectious Diseases
COLPOS	Colegio de Posgrados en Ciencias Agrícolas College of Graduate Studies in Agricultural Sciences
CONACyT	<i>Consejo Nacional de Ciencia y Tecnología</i> National Council of Science and Technology
COVECyT	<i>Consejo Veracruzano de Ciencia y Tecnología</i> Veracruz's Council of Science and Technology
COVEICYDET	<i>Consejo Veracruzano de Investigación Científica y Desarrollo Tecnológico</i> Veracruz's Council of Scientific Research and Technological Development
EU	European Union
FOMIX	<i>Fondos Mixtos</i> Mixed Funds Programme
GDP	Gross Domestic Product
HE	Higher Education
HEI	Higher Education Institution
ICT	Information and Communication Technologies
IMCO	<i>Instituto Mexicano para la Competitividad</i> Mexican Competitiveness Institute
IMHE	OECD Programme on Institutional Management in Higher Education
INIFAP	<i>Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias</i> National Institute of Forestry, Agriculture and Livestock Research
ITESM	<i>Instituto Tecnológico y de Estudios Superiores de Monterrey (Tec de Monterrey)</i>

	Monterrey Institute of Technology and Advanced Studies (Monterrey Tech)
ITS	<i>Instituto Tecnológico Superior</i> Advanced Technical Institute
LANIA	<i>Laboratorio Nacional de Informática Avanzada</i> National Laboratory of Advanced Computing
LATEX	<i>Laboratorio de Alta Tecnología de Xalapa</i> Advanced Technology Laboratory in Xalapa
LEED	OECD Local Economic and Employment Development Programme
MXN	Mexican peso
NAFTA	North American Free Trade Agreement
NGO	Non-governmental organisation
OAS	<i>Organización de los Estados Americanos</i>
OEA	Organisation of American States
OECD	Organisation of Economic Co-operation and Development
PEMEX	<i>Petróleos Mexicanos</i> Mexican Oil Company
PROMEP	<i>Programa para el Mejoramiento del Profesorado</i> Faculty Improvement Programme
PYME	<i>Pequeña y mediana empresa</i> Small and medium-sized enterprise
REINCUVER	<i>Red de Incubadoras de Empresas del Estado de Veracruz</i> Network of Business Incubators of the State of Veracruz
RENIECyT	National Registry of Scientific and Technological Institutions and Firms
RIS	Regional Innovation System
SBDC	Small Business Development Centre
SME	Small and medium-sized enterprise
SNI	<i>Sistema Nacional de Investigadores</i> National Researchers' System
SEV	<i>Secretaría de Educación de Veracruz</i> Ministry of Education of the State of Veracruz
SEP	<i>Secretaría de Educación Pública</i> Ministry of Public Education

Assessment and recommendations

The State of Veracruz: from a lagging region to a centre for human capital development

Mexico is an emerging economy that has undergone a period of economic transition and reforms over the last 20 years. Thanks to the North America Free Trade Agreement (NAFTA), revenue derived from Mexico's oil production, a large domestic market, political and macroeconomic stability, policy reforms and remittances from its diaspora, Mexico has emerged as the second-largest economy in Latin America after Brazil. However, the current economic and financial crisis has severely affected Mexico. In 2009, GDP decreased by 6.5% causing widespread unemployment and reduction in public spending.

Poverty and social exclusion remain serious concerns in Mexico. In 2006, 42.6% of the population suffer from some form of poverty; there is also a high degree of social inequality. Sustained economic growth is necessary for increasing the quality of life of the population, particularly of people from lower socio-economic backgrounds. Mexico's human capital, measured by years of schooling is one of the lowest in the OECD and its academic results are lagging behind the OECD average, according to the PISA results. The chances of Mexico achieving sustainable growth will significantly depend on its ability to improve its education system.

The State of Veracruz is located in the south east of Mexico, along the Gulf of Mexico. With a population of 7.1 million, Veracruz is the third most populous state in the country. However, the state's population growth rate is below the national average due to negative migration balance: the state loses both highly-skilled and low skilled population. While the population is young and mainly urban, its rural inhabitants still make up 40% of the total population, compared to 27.6% nationwide. Veracruz also features the third largest indigenous population in the country. Poverty levels are high among the low skilled population.

The regional economy of Veracruz is dominated, on the one hand, by small and medium-sized enterprises operating in the traditional economy, particularly in the agricultural sector, and on the other hand, natural resource-based industries, such as electricity production, oil and gas extraction, which are mainly controlled from outside of the region. Recently, progress has been made in improving efficiency in production processes and product quality but overall, the productivity and the industrial capacity remain limited.

Despite considerable expansion of the education sector, Veracruz lags behind the Mexican averages in key education indicators, which in turn are significantly below the OECD average. The poor performance of the education system results in a relatively small pool of well-educated graduates from secondary and higher education systems. The economic structure in Veracruz and the underinvestment in human capital development have resulted in low income levels and high poverty rates. In the Mexican context, Veracruz is a “lagging and under-performing region”.

Veracruz is faced with the need to develop a knowledge-intensive economy, to increase the prosperity of the state and to address poverty and inequality. The low-skilled population is an obstacle to the economic development as it slows down the development of knowledge-intensive industries. Veracruz must therefore achieve improvement throughout its entire education system. In the context of the gaps in both economic development and education outcomes, the key challenges for Veracruz and its tertiary education institutions are:

- How to improve the overall education attainment levels and ensure that education provision is aligned with the needs of Veracruz?
- How to leverage the current economic base and promote new business formation?
- How to tackle poverty and social inequality in Veracruz?

To address these challenges, the State of Veracruz needs joint efforts in regional development including a human capital and innovation strategy, with a vision, measurable goals, milestones, co-ordination measures and robust evidence base. Tertiary education provision needs to be better aligned with the needs of Veracruz, by building stronger links between institutions and industries in the region. National and state authorities and tertiary education institutions need to join efforts to improve access and success in education by providing stronger academic, social and financial support for students and engaging in long-term collaboration with schools. Pathways between the technical education sector and universities need to be

strengthened. Research, development and innovation efforts need to build on the existing and emerging advantages of Veracruz.

Human capital development in Veracruz

The State of Veracruz has made commendable efforts to strengthen the regional economy through investments in education and by providing up-skilling opportunities for the labour force. The tertiary education sector has expanded significantly and the access to education has increased mainly as a result of the establishment of technological institutes. Today, Veracruz is the leading state in Mexico in terms of the number of state technological institutes.

The Mexican's education system has radically expanded and diversified over the last fifty years. Nonetheless, Mexico's human capital capacity is limited and the average year of study is only 8.1, one of the lowest in the OECD area. The efficiency of the primary and secondary education system is low in light of the increased education spending per student. Mexico underperforms in international tests of secondary education learning outcomes such as the OECD Programme for International Student Assessment (PISA). In tertiary education, the number of students has increased from 1.25 million students in 1990 to 2.7 million in 2008-09, but at 34%, the tertiary education enrolment rate remains considerably below the OECD average (of 56%).

In Veracruz, there are 174 270 tertiary education students, with 67.5% of students attending public universities and 32.5% private institutions. The leading institution is the Universidad Veracruzana (State Public University of Veracruz), a public research-based university that accounts for 36.5% of the total enrolment in the state. As elsewhere in Mexico, the geographical expansion of existing and new institutions and the diversity of the institutions have increased the tertiary education enrolment. For example, the Universidad Intercultural Veracruzana (Intercultural University of Veracruz) launched by the Universidad Veracruzana with the support from the Ministry of Public Education has established four campuses in remote rural areas and indigenous communities. More importantly, Veracruz has seen a 50% increase in student enrolment in the technological institutes in the last five years, with 43 967 students representing 31% of the total

enrolment of tertiary education students in the state. Today, the State of Veracruz features the highest number of state technological institutes (21) in Mexico. The technological institutes have higher than average enrolments in engineering which provide a strong basis for innovation in future.

These improvements will eventually have an impact on tertiary education attainment levels and contribute to reduced poverty rates in Veracruz, provided that a larger number of graduates will find employment in the region. Currently, about half of the tertiary education students come from the neighbouring states signalling the attractiveness of the Veracruz educational system, but also highlighting the underlying supply-demand problem. Many of the graduates leave the region in search of job opportunities.

Work is needed in order to continue and consolidate the gains accomplished, and improve the access to education.

The key education indicators in Veracruz remain lower than national averages and significantly lower than OECD averages: the average years of schooling in Veracruz is 7.2. The rate of completion of upper secondary education in Veracruz is 26.8% and the tertiary education enrolment rate is 25.1%. Poor outcomes in the primary and secondary education system combined with the limited capacity of tertiary education institutions undermine the efforts to enhance participation in education and economic development. Furthermore, only 5.4% of tertiary education students are studying at a graduate level, revealing a lack of capacity to train highly-specialised personnel for the regional economy.

Widening access to and ensuring quality and success at all levels of education remain a key policy challenge in the State of Veracruz. National and state authorities need to address the challenges in primary and secondary education in a comprehensive manner, by improving the quality of the education offered and mobilising appropriate levels of financial resources. Universities and other tertiary education institutions should strengthen these efforts by engaging in long-term collaboration with schools in order to raise aspirations among students and to improve quality of teaching.

To improve graduation rates and learning outcomes of students and to boost entrepreneurship in Veracruz, the tertiary

education system needs to become better aligned with the needs of the region and its population.

Universities in Veracruz are primarily focused on national labour markets and career-centred education provision. There is a need to move towards a more demand-led education provision, to reform the traditional teacher-centred learning models, to strengthen the development of competencies of the students and to build stronger links between tertiary education institutions and labour market. This could be achieved through a wide range of measures, including academic, social and financial support for the first generation students, work-based learning for students, for example through co-op education in collaboration with the local industry and other employers, participation of employers in the curriculum and course design, and tracking of student progress, achievement and labour market outcomes. In addition, the use of local private sector employees as instructors and supporting the movement of university researchers/teaching staff on a temporary basis to the private sector would be useful ways of improving the labour market relevance. Finally, improving active language skills of all students and faculty are necessary if the region wishes to position itself in the global market.

Positive development in improving students' learning outcomes and labour market relevance of education is taking place in tertiary education institutions that participate in national-level projects, such as CESAL-INNOVA and AULA, which aim to improve university teaching and train faculty in student-centred learning models. The Universidad Veracruzana has engaged in a long-term process to modernise its learning/teaching model. It has also launched work-based learning programmes, such as *brigadas en empresas* (enterprise brigades), along with the Anahuac University's mentoring programme. In general however, only a small proportion of students benefit from this type of initiatives which remain discipline-based, covering only undergraduate students and lack wider dissemination throughout the tertiary education sector in the state.

Collaboration with industry is more intense within the technological institutes that offer practice-oriented associate degree programmes in engineering-related fields. Employers participate in the institutional governance, design of programmes and curricula, and provide internships which are part of course requirements. Similar arrangements would benefit also the university sector, but to date appear less frequent.

Veracruz has high levels of self-employed but a low rate of knowledge-based business creation. Finding ways of increasing entrepreneurship could be an effective strategy to facilitate graduate retention and job creation.

Tertiary education institutions have taken steps to boost university spinoffs and graduate entrepreneurship, mainly through incubators, such as the Universidad Veracruzana's Incuba and the technological institutes' Business Incubators Network. However, the provision of entrepreneurship education should be scaled up, by using interactive and experiential teaching methods. The focus could be on growth-oriented entrepreneurship through technology incubators, as well as social and cultural entrepreneurship. Entrepreneurship education should be integrated into Masters and PhD programmes and work-based learning programmes.

Due to the rapidly changing skill requirements, skills upgrading, re-skilling and other forms of lifelong learning are becoming increasingly important. This is particular relevant for Veracruz where the adult population has had limited opportunities for education. To date, the tertiary education sector in Veracruz remains more oriented to meet the needs of traditional students than those of adult learners. While the institutions are aware of the needs of adults and have some programmes in place for them, not enough robust data is available to understand the needs of this population or the efficacy of tertiary education in meeting them. Programmes aimed at non-traditional learners need to be expanded and scaled up to enhance the flexibility of the population to adjust to the rapid changes in the labour market and to improve productivity. Strong efforts should be made to extend the existing good practice examples, such as programmes provided by the Mexican Institute for Adult Education and by Monterrey Tech.

There is also a need to address the segmentation of the tertiary education system and the lack of pathways available for students to progress.

One of the main factors impeding human capital development in Veracruz is the absence of state-wide mechanisms to articulate a long-term vision and implement an integrated development strategy for all educational institutions. Transparent pathways for students through the education system are required. The current segmentation of university and technological education sectors act as an impediment for student mobility and human capital development. Measures to widen access should be supported with the development of clear and transparent pathways, for example between technological institutions and universities. Students, who have completed courses at technological institutions, should be able to transfer into university degree programmes. This would involve the development of stronger credit recognition schemes, course and programme articulation

agreements, clear and enforceable policies related to credit transfer and increased support for joint and collaborative programmes. A potential step in this direction could be the establishment of a national qualifications framework to facilitate progression from one degree type to another, to allow credit for previous academic and job-related experiences and competencies, and to ease transitions between areas of study.

The following measures would promote human capital development in Veracruz:

The OECD review team recommends the following measures are taken in promoting human capital development:

- The state government, tertiary education institutions, other educational institutions and key stakeholders of the economy and society should collaborate to agree on region-wide goals, policies and priorities for human capital development from primary to tertiary education, including also workforce development activities. Tertiary education institutions and the government should establish a co-ordinating body to address pathways between universities and technological institutes and different levels of education. Measures should be put in place to accommodate and encourage mobility within and between institutions by formal agreements to help students move from one institution to another.
- The state government and tertiary education institutions should expand efforts to increase the enrolment and success of students from low social and economic background. This would require the removal of the remaining geographical barriers to education, developing academic, social and financial support services for students and building close collaboration between the tertiary education and the primary and secondary education institutions.
- The state government and tertiary education institutions should significantly increase tertiary education opportunities for working age adults, building on the existing courses offered by INEA, Monterrey Tech (online programme) and other universities in Veracruz. The lifelong learning measures should include transparent pathways to advanced education, the ability to attend multiple institutions, obtain short-term education and training that can later be applied to degrees, and re-skilling and up-skilling courses and programmes designed around the needs of working adults. This involves the development of a qualifications framework with strong credit recognition schemes, course and programme articulation

agreements, clear and enforceable policies related to credit transfer and support for joint and collaborative programmes.

- The state government and tertiary education institutions should improve the data on student labour market outcomes and labour market needs and trends. Tertiary education institutions should systematically monitor student progress and achievement and labour market outcomes and graduate destinations (out-migration). The most effective regional graduate labour market systems are based on the collection of comprehensive labour market intelligence and the on-line publication of the data in a single place to improve students' ability to make rational choices about their studies and to help graduates and employers come together and increase the graduate chances of gaining employment. This data can also be use strategically to identify regional priorities and at an institutional level, to develop course provision and the supply of employer-specific skills.
- Tertiary education institutions should develop a stronger student-centred approach in their teaching activities. This should be built on the international best practice and the existing models in Veracruz. These new forms of education should be more interactive and more tailored to the individual needs and capacities of students and involve work-based and problem-based learning methods and programmes to develop employability, entrepreneurial and transferable skills and English language acquisition. The transferable skills should be embedded in degrees programmes across the academic disciplines (not just in business or accountancy degrees). This would boost the productivity base of the region and enhance its internationalisation efforts.

Social service in Veracruz

The challenges in Veracruz are manifold, ranging from poverty and social exclusion, ethnic diversity and urban-rural divide to environmental degradation and hazards.

The social conditions in Veracruz have improved in the last two decades. Still, in the national comparison, it is one of the states with the highest proportion of poor: more than 50% of the population live in various degrees of poverty, compared to a national average of 42.6%. Several

municipalities and the majority of the state are substantially below the national average in terms of UNDP Human Development Index that combines life expectancy, education attainment and per capita income. Veracruz is also ethnically and culturally diverse: it has the third-largest indigenous population in Mexico, over 605 000 people. Furthermore, economic growth and environmental hazards, such as oil spills, floods and hurricanes have led to increasing pressures on the environment that has one of highest concentrations of biodiversity in the world.

Tertiary education institutions see widening access as an important contributor to regional development. They also provide a wide range of services in the health and social sector.

Universities and other tertiary education institutions in Veracruz see widening access and increasing participation of students from lower socioeconomic backgrounds as their key social contribution to regional development. Increased access of students in rural and remote areas has been facilitated by the Universidad Intercultural Veracruzana (Intercultural University of Veracruz) that has provided permanent university presence among indigenous populations in remote areas, the state government's innovative Vasconcelos project that uses mobile learning units and the establishment of technological institutes. Supported by the Ministry of Public Education and the State Government of Veracruz, tertiary education institutions have each developed their own projects and approaches to widening access and school collaboration.

Universities also provide a wide range of services to different communities, usually in the health and social sector. Valuable work is carried out in rural and remote areas where many tertiary education institutions reach out to the low income population. Most initiatives address sector-specific issues, but they lack a more integrated approach to local economic and social development in the region. Much of this outreach is conducted by students as part of their social service obligation.

Mexico has a tradition in community service and outreach through students' social services. Tertiary education institutions in Veracruz follow the national requirement that all university students must complete extensive

social service. Casas de la Universidad developed by the Universidad Veracruzana (State Public University of Veracruz) represents an example of good practice in this area. Despite innovative approaches to collaborate with communities that are harder to reach, there is a need for collaboration and co-ordination between universities, monitoring of results and a move towards sustainable community development.

In Mexico, the national requirement of mandatory student social service as a graduation requirement has generated good results in mainstreaming community service activities into the core business of universities and providing experiential learning opportunities for students. For example the Universidad Veracruzana has included a minimum of 480 hours of social service in the curricula. Participation of students in the university's service learning/internship programme averages 250 students per semester/year. Similarly, Monterrey Tech's campus in Veracruz has a community service programme which engages students in programmes that generate social, economic and education development in marginalised communities and social assistance organisations.

The programmes developed by the Universidad Veracruzana and other tertiary education institutions are notable for their partnerships with external stakeholders, such as municipalities, and capacity to work across all sectors in sustained commitment. However, there is limited evidence of collaboration across the tertiary education sector and systematic monitoring of results which would help evaluate the outcomes of outreach activities and facilitate scaling up good practice examples into a system. But the resources are spread thinly and the scope and impact of the activities are often constrained by short-term project funding and interventions.

There is also a need to empower disadvantaged communities to address their own challenges by strengthening the social economy, cultural identity and environmental development.

Community development programmes aim to build capacity by enabling communities to respond to social, economic and environmental challenges. The Universidad Veracruzana has taken an important step to develop long-term community presence through the *Casas de la Universidad* where students deliver wide-ranging services for the local population. Through multidisciplinary action, *Casas de la Universidad* could be developed into

community development centres that build capacity in the rural and remote areas to help communities to help themselves. The university is also supporting local development by bringing in training and knowledge required for the development and implementation of local strategies.

Universities and other tertiary education institutions, in collaboration with local and state authorities, could also play a more prominent role in training community development practitioners, providing lifelong learning and re-skilling opportunities, conducting research into specific issues and developing low-tech and low-cost innovations which could bring concrete improvements in everyday life. There is also considerable underused potential in environmental and cultural development as well as international collaboration beyond Spanish speaking regions.

The following measures would enhance the contribution of tertiary education institutions to the social, cultural and environmental development in Veracruz:

- In addition to widening access and providing services to disadvantaged communities, tertiary education institutions should make use social service obligations to engage in long-term community development seeking ways to empower communities to find their own solutions to economic, social, cultural and environmental challenges.
- A systematic exchange of information and experience should be put in place between tertiary education institutions in social, cultural and environmental matters facilitated, for example by the state government in order to bring greater efficiency in social service activities. This forum could organise thematic events, with regular information retrieval and exchange facilitated by a dedicated website. As a first step, the tertiary education institutions' current connections, initiatives and projects in social service should be mapped and published in the collaboration platform.

Innovation in Veracruz

In the last few years, progress has been made in establishing the elements of the regional innovation system in Veracruz. However, the low levels of R&D expenditure, limited absorptive capacity in the SME-based economy and the concentration of research in a limited

number of areas have slowed down the progress.

Mexico has one of the lowest levels of R&D expenditure in the OECD area, but has, in recent years, made progress in establishing a national innovation system. The National Science and Technology Council (CONACyT) also provides some incentives for regional engagement of tertiary education institutions to foster knowledge transfer and university-industry collaboration, and the Science, Technology and Innovation (STI) Policy is increasingly recognising the importance of regional innovation systems. However, national policies do not yet sufficiently support regional innovation systems or clusters and innovation resources remain concentrated in Mexico City. This slows down the capacity building at the state and sub-national levels and affects states such as Veracruz.

The State of Veracruz has been relatively slow in implementing the elements of a regional innovation system. The state innovation sector is under the supervision of the Veracruz Council for Scientific Research and Technological Development (COVEICYDET) which has produced the State Science and Technology Plan (2005-10). The resources dedicated to the plan as well as the institutional capacity to plan, develop and implement innovation policy are in need of strengthening. The Veracruz Council of Science and Technology (COVECyT) was established in 2006 as the last state-level innovation agency in Mexico. The financial resources for RDI remain limited and heavily concentrated on applied research, with limited focus on business innovation. Financial support, totalling about USD 10 million, has been channelled through the competitive FOMIX research programme which is funded by a combination of federal and state funds.

Given the concentration of innovation resources in Mexico City and Veracruz's aspirations for a knowledge-orientated economy, Veracruz and other developing states need to implement their own specific programmes to overcome innovation deficit. The State Government of Veracruz has taken up the challenge by launching an innovation fund which will replace fiscal stimuli. Provided that FOMIX and the new innovation fund will continue to operate, the state will have two powerful policy instruments at the service of innovation and can target at specific constituencies, such as different types of businesses, or develop sector-based strategic policies, aimed at agribusiness, environmental or energy sectors.

The current outcomes of research and innovation activities reveal considerable

underutilised potential and call for a stronger collaboration and knowledge exchange mechanisms between tertiary education institutions and firms.

The research system in Veracruz is composed of public research institutes and a few large firms. The Universidad Veracruzana dominates the research system and is a home to research centres, such as the Advanced Technology Lab in Xalapa (LATEX) and the College of Graduate Studies in Agricultural Sciences (COLPOS). There are also several technological institutes and a small number of federal research centres, such as LANIA (computer science), the Institute of Ecology (INECOL) and the National Institute of Forestry, Agriculture and Livestock Research (INIFAP). Infrastructure for developing R&D human resources includes nine public research centres and the National Registry of Scientific and Technological Institutions and Firms (RENIECYT), a network of 157 organisations engaged in S&T and innovation activities. There are 410 National Researchers System (SNI) researchers in the state. Veracruz has 1 230 students in graduate programmes supported by CONACyT, with 45% enrolled in doctoral programmes.

The State of Veracruz and its tertiary education sector have taken steps to build capacity for knowledge generation and transfer but the results remain modest as measured by the low level of scientific publications, patents and spinouts. This can be attributed to a range of reasons, such as the lack of university-industry collaboration, a narrow spectrum of research fields (mainly agri-food, basic metals, health, petrochemicals and energy), limited investment in R&D (not exceeding 0.1% of the state GDP), a small number of SNI researchers in technological disciplines and the university faculty's focus on knowledge generation (publication) rather than knowledge transfer.

The transformation of Veracruz's economy and the ability to increase productivity and competitiveness depend on whether its key institutions will have the capacity to develop their research and innovation. As the main research university in the state, the Universidad Veracruzana should consider creating a strong infrastructure for knowledge transfer/exchange and innovation, backed up by sufficient funding and promote spinoffs and encourage student and faculty interaction with businesses and industry. There is a need to improve incentive structures to mobilise universities and their faculty for regional development. In view of the significant progress made by the states such as Jalisco and Nuevo León in internationalisation, there is an urgent need to strengthen the international dimension of the Veracruz tertiary education sector.

The technological institutes have often stronger links with the productive sector, even if they have not reached the original target of attracting 25% their funding from the private sector. They have also undertaken the important task of capacity building in the firms and are developing their RDI capacity and international links. Stronger collaboration between university and the technological institutes would yield positive results for the regional economy. Tertiary education institutions in Veracruz should increase their efforts to participate in international collaborations projects in the field of technology with European and Asian countries which have a strong tradition in technological education. To achieve this goal, it is recommended that an international office at state government level (Veracruz Ministry of Education) is established to promote and co-ordinate international collaboration projects in the higher education sector.

The state and tertiary education institutions should reinforce the innovation system, focusing on sectors and clusters where there is regional economic potential. Collaboration between tertiary education institutions and local firms should also be encouraged in both educational and research-orientated tasks.

The development of a knowledge-intensive economy in Veracruz would benefit from tertiary education institutions and regional firms collaborating on research and innovation. The building blocks of an innovation system are in place with a research-orientated university, technological institutes and the regional research council. However, the regional innovation system does not encourage tertiary education institutions and regional firms to build on the existing industries and sectors in the areas of spin-off activity, knowledge transfer and provision of education and training courses. Greater co-operation could enable Veracruz to increase the labour productivity of their companies and to compete in the global economy.

Industry-university relationships work, when there is an interest and an ability from small firms to co-operate with academic institutions. Policy measures that boost skills development, people-based mobility between universities and industry and innovation purchasing can stimulate the demand for HE R&D. Local firms in Veracruz tend to be small and need to be exposed to the importance of innovation and collaboration with tertiary education institutions through initial awareness campaigns. Currently, firm innovation in Veracruz takes place mainly through relationships with business partners (clients and suppliers) and imitation of competitors. While

this strategy is well suited for incremental improvements, it is less appropriate for radical breakthroughs in the production process.

A state and institutional strategy for collaboration between tertiary education institutions and the private sector would enhance the impacts of such relationships on innovation and economic growth. Based on an analysis of regional existing or emerging strengths, the strategy should identify the driving sectors or cluster of the economy, for example chemical and plastic sectors given the local oil industry, biotechnology for the pharmaceutical sector, the environmental and energy sector, and tourism. The strategy should also secure funding and institutional collaboration between the tertiary education institutions and firms in these areas. The cross-fertilising potential of cutting-edge technologies should be better recognised and exploited to foster new value-added sectors. Non-high-tech industries and services should also be a target, but would require the university to better exploit its research potential in areas such as tourism, logistics, construction, waste management, water quality and solar energy *i.e.* areas congruent with Veracruz's real or anticipated comparative advantages. Finally the university should use the region and its diverse range of challenges as a "laboratory" for developing research and innovations.

The following measures would promote regional innovation in Veracruz:

The OECD Review Team recommends the following measures are taken in promoting innovation development:

- The federal government should improve the evidence base of the RDI performance by collecting robust data about the state-level performance. This data should be made available on-line in order to develop strategic intelligence at the sub-national level, to facilitate comparisons between the states and regions abroad, and to provide a catalyst for shared learning. The European Innovation Scoreboard could be a source of inspiration in this context. The federal government could establish guidelines that would help the states to refine their statistical instruments. Data should be improved in terms of human capital development (*e.g.* population with tertiary education, participation in lifelong learning, youth education attainment level), innovation throughputs (*e.g.* patents, spinoffs and start-ups) as well as output indicators.
- The state government in collaboration with the leading tertiary education institutions and the business sector should develop a clear strategy for regional development, innovation and growth. Such a

strategy should be based existing strengths and develop related sectors and technologies. The strategy should be backed with adequate level of investment in human resources and infrastructure to guarantee effectiveness. The strategy should draw on a diagnosis that identifies the key driving sectors of the economy. The government should ensure that research on clusters and demands of industry extend into service sector and include clusters such as tourism. Clusters should be conceptualised as cutting across the manufacturing-service divide – for example agribusiness clusters usually connect with tourism and manufacturing innovations incorporate service components.

- Tertiary education institutions in Veracruz should increase their efforts to participate in international collaboration projects in the field of technology with European and Asian countries which have a strong tradition in technological education. To achieve this goal, it is recommended that an international office at state government level (Veracruz Ministry of Education) is established to promote and co-ordinate international collaboration projects in the higher education sector.
- The state government should encourage more systematic and institutional collaboration between tertiary education institutions and local firms. This collaboration should focus on areas where Veracruz has a real or potential comparative advantage, for example chemistry and the plastic sector due to the presence of the local oil industry, biotechnologies for the pharmaceutical sector, rather than on a narrow sector specialisation. Technologies with cross-sector fertilisation potential should be promoted. Universities should work to ensure that local firms are aware of the benefits of hiring graduates.
- The state government should encourage collaboration between the tertiary education institutions and local small and medium-sized enterprises (SMEs). Policy tools include people-based mobility schemes, such as the Knowledge Transfer Partnership in UK, that improve the absorptive capacity of local enterprises and support for the forum role of tertiary education institutions to reinforce the regional engagement channels. A relatively low-cost policy measure that have been implemented in a number of countries, for example in the Netherlands, the UK and Ireland, is innovation vouchers that expose firms to innovation activities and stimulate a market for innovation. They are small-scale lump sums that firms receive to undertake simple innovative projects. Rules and procedures should

be kept as simple as possible and the whole administration process should be managed at the state level, preferably by COVECyT, to guarantee faster examination and approval. Alternatively, the system could be administered directly by a university. It should be noted, however, that this could raise potential conflicts of interest if the university is also an eligible “supplier” of innovation. At the operational level, innovation vouchers can be tweaked depending on specific needs and objectives. For instance, they can focus on specific sectors or technologies or business-to-business collaboration by only allowing applications from groups of firms. Different rounds of calls for applications can be organised to meet different goals and needs.

- Tertiary education institutions should establish a range of links with the local business community. Universities should consult more with the local firms to design research programmes and activities that are more strongly aligned with their needs and expectations. Collaborative research programmes could help improve links between the tertiary education and business sectors.
- Tertiary education institutions should clearly identify the goals and objectives of the business incubators before the launch of the incubator in order to have impact on the selection criteria of tenant firms and the evaluation of the programme. Business incubation schemes are economic rather than social tools and the limited evidence suggests that the most positive effect is on firm survival rates and employment generation (the latter applies mainly to technology incubators). A focus on broad sectors would better benefit tenant firms. Tertiary education institutions should also emphasise the element of flexibility in the provision of business support services in incubators to ensure that the tenant firms have access to an integrated array of services, whether available in-house or outside of the incubator. The selection of services provided by an incubator should depend on the services available in its vicinity. The provision of a full range of support services is not necessary and will unduly add to overhead costs. Likewise, specialised services can be contracted when needed.
- Tertiary education institutions, especially the Universidad Veracruzana should launch technology-based incubators. Technology incubators represent an increasing share of incubators in the world and are often linked directly or indirectly to local universities. Incubators can also be designed without physical facilities, with a focus on the provision of services, with often a

stronger emphasis on intellectual property protection and other legal aspects.

- The Universidad Veracruzana should make stronger efforts to improve the links with the local manufacturing sector in order to encourage the introduction of product and process innovations. It should improve its institutional capacity to engage with the local industry by developing a regional development strategy that would encompass technology transfer and innovation as well as new business generation. It should establish a professional technology transfer office that will actively reach out to local business and industry. It should mobilise its existing national and international connections for the benefit of regional development.
- In addition to providing services to various communities, tertiary education institutions should engage in challenge-driven research, using the region and its diverse range of challenges as a “laboratory” for developing research and innovations. Combining community outreach into training and challenge-driven research can generate improvements in life quality and low tech innovations.

Chapter 1: Veracruz in context

This chapter presents the socio-economic profile of the State of Veracruz, and the education system of Mexico.

Veracruz, is the third most populated Mexican state. The state's population growth rate is, however, below the national rate due to negative migration balance. While the population is young and increasingly urban, rural inhabitants still make up 40% of the population, compared to 27.6% nationwide. At the same time, there is a high degree of geographical dispersion of the population. Veracruz also has the third largest indigenous population in Mexico. Poverty levels are high among the low skilled population and the overall educational attainment levels significantly below the national average.

Out of 31 states and the Federal District, the contribution of Veracruz to Mexican gross domestic product is the fifth largest. This is due to the strong natural resource-based industries, such as electricity production, oil and gas extraction, which are mainly controlled from outside of the region. At the same time, the economy is dominated by small and medium-sized enterprises. The primary sector – agriculture, livestock and fishing – continues to play an important role in employment.

1.1 The economic context of Mexico

Mexico began a period of reform and economic modernisation 20 years ago, motivated by the experiences of the “lost decade” of the 1980s. As a result, the economy was opened to foreign trade, mainly through the North American Free Trade Agreement (NAFTA) in 1994. After the 1995 crisis Mexico has achieved macroeconomic stability. Double-digit inflation has abated since 1999, and current account and fiscal deficits have been avoided so far. Other positive developments include the accumulation of a foreign currency reserve, the stability of the national currency and a policy promoting low interest rates. In recent years, Mexico, as an oil producing country, has benefited from the increase in oil prices. Incomes have been enhanced also thanks to remittances from Mexicans living in the United States. As a result, Mexico is now the second-largest economy in Latin America after Brazil.

Mexico’s GDP annual growth over 2000-07 averaged 2.9%, compared to 3.8% in Chile, 7.8% in India and 10.1% in China (Brazil grew at an average rate of 2.8%). In 2009, GDP decreased 6.5%, causing widespread unemployment and reduction in social spending, including on education (INEGI, 2010a). Mexico has been severely affected by a deep recession as a result of the global economic crisis and the swine flu (H1N1) outbreak (OECD, 2009a). While indicators predict recovery for some countries during 2010, in the case of Mexico the future remains more uncertain. Strong economic growth is necessary to reduce the number of people living in poverty and marginal conditions.

According to the Global Competitiveness Index (GCI), the level of productivity, competitiveness and potential sustained growth of a country is determined and triggered by the existence or absence of a certain number of institutions, policies and factors. This index classifies countries into factor-driven, efficiency-driven and innovation-driven stages of development. Mexico was recently categorised as being in the efficiency-driven development stage, along with countries such as Chile, Uruguay, Poland, Russian Federation and Turkey. Although Mexico ranked 66th among 139 countries with a composite score of 4.19 out of a possible 7 points, the country’s performance lags behind in the following areas: labour market efficiency, institutions, insecurity, goods market efficiency, tertiary education and training, scientists and engineers, and innovation. Nevertheless, Mexico also possesses certain competitive advantages, such as a stable macroeconomy and one of the largest world markets (12th among the 139 reviewed countries in the GCI) (WEF, 2010).

Mexico's economic future depends on structural reforms to be implemented to increase productivity and improve international competitiveness. These reforms are designed to overcome the deficient education system, the high cost of energy inputs, the narrow tax base now in critical condition due to the scant oil revenues, the overdependence on the US export market, and the shallow credit market (WEF, 2009a; EIU, 2009). The lack of structural reforms will make recovery even more difficult in the short term. In the long term, if these reforms are not implemented, the future growth capacity and competitiveness of the Mexican economic sector will be at risk.

1.2 The socio-economic context of the state of Veracruz

Located at the Gulf of Mexico, the State of Veracruz represents 3.7% of the Mexican territory. It is 745 km long, representing 29.3% of the Mexican Gulf coast and covering an area of about 72 500 km². It is one of the highest concentrations of biodiversity in the world, with its rich hydrological resources. At the same time, the state has the highest number of environmental emergencies in Mexico due to oil spills, floods and hurricanes.

With 7.1 million inhabitants, 6.9% of Mexico's population lives in Veracruz. Demographically, it is the third-largest of the country's 31 states and the Federal District, but its GDP is only the fifth largest in the nation. Most of the Veracruz's population is very young, with 44% (3.1 million) between 3 and 24 years old. The state has a slightly smaller proportion of the economically active population (55.1%) than the national average (58.7%). Life expectancy is 71.3 years for men and 76.2 years for women compared to the national average of 72.6 years and 77.4 years, respectively. Veracruz has the third-largest indigenous population (605 135 inhabitants) after the states of Oaxaca and Chiapas. About 10% of its population speak an indigenous language.

Migration keeps the population growth rate in Veracruz low, even if emigration to the United States is below the national average: 11 people out of 1 000 migrate to the north (compared to the national average of 16 out of 1 000). There are limited migration flows into the state to compensate the loss of both highly-educated and low skilled population.

Rural inhabitants make up 40% of Veracruz's population,¹ in contrast to 27.6% nationwide. The state is sparsely populated: 47% of the population lives in towns with less than 2 500 inhabitants or in villages with less than 500 inhabitants, compared to 29% nationwide. The geographical dispersion

of population increases the cost of transport and communication services and poses a challenge for service delivery.

Veracruz is divided into ten administrative regions according to natural characteristics and the influence of urban development on surrounding communities (see Figure 1.1.). There are also nine metropolitan areas within some of the ten regions (see Table 1.1.).

Figure 1.1. The State of Veracruz and its administrative regions

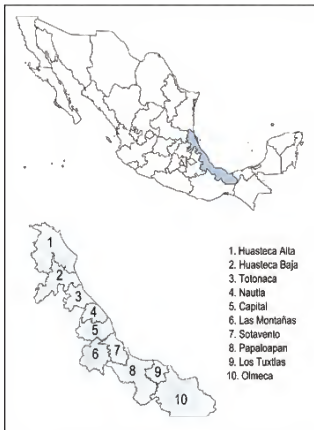


Table 1.1. Veracruz's regions and metropolitan areas

Region	Metropolitan areas	Population %	Urban %	Rural %	Veracruz GDP %
Huasteca Alta	Tuxpan and Pánuco	7	41	59	2.7
Huasteca Baja		8	34	66	3.7
Totonaca	Poza Rica	9	56	44	5.1
Nautla		5	46	53	1.2
Capital	Jalapa	14	56	34	6.9
Las Montañas	Córdoba and Orizaba	18	47	43	13.5
Sotavento	Veracruz	12	80	20	25.4
Papaloapan		8	52	48	3.9
Los Tuxtlas		4	45	55	1.0
Olmeca	Coatzacoalcos, Minatitlán and Acayucan	16	73	27	36.5
Total		100			100.0

Note: The table is sorted by rural percentage of population.

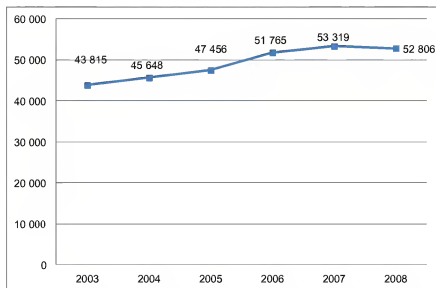
Source: Gobierno del Estado de Veracruz (Government of the State of Veracruz) (2005a), "Estudios Regionales para la Planeación" (Regional Studies for Planning), Xalapa; INEGI (2010b), *Perspectiva estadística Veracruz*. (Veracruz Statistics), from INEGI: www.inegi.org.mx/est/contenidos/espanol/sistemas/perspectivas/perspectiva-ver.pdf, accessed 21 September 2010.

Within the state of Veracruz, two regions, Sotavento and Olmeca, are predominantly urban due to the presence of the metropolitan areas of Veracruz, Coatzacoalcos and Minatitlán. They make up 28% of the population and 62% of the state's GDP. The remaining eight regions have a large rural population ranging from 34% to 66%. The socio-economic characteristics of the Sotavento and Olmeca regions are thus very different from the socio-economic structures of the rest of the state.

The economic activity of Veracruz accounts for 4% of Mexico's GDP and in terms of regional GDP, is ranked fifth in the country. In contrast, the state's GDP per capita ranks 26th in the country despite the consistent growth in the last decade before the global economic crisis. (see Figure 1.2.).

Figure 1.2. GDP per capita in Veracruz, 2003-2008

In Mexican pesos (MXN)



Source: Gobierno de los Estados Unidos Mexicanos (Government of the United States of Mexico) (2010), "Cuarto Informe de Gobierno" (Forth Governmental Report), México City, <http://cuarto.informe.calderon.presidencia.gob.mx/anexo-estadistico/>, Accessed 20 September, 2010.

Veracruz's economy is dominated by a traditional economy that relies on natural resources. Veracruz's primary sector – agriculture and livestock – accounts for 5.3% of the entire state's economy, compared with the national average of 3.6% (See Table 1. 2.) This sector also occupies 71.4% of the state's territory. Mainly due to the oil production, the Veracruz industrial sector is larger (37.8%) than the national average (30.2%). In contrast, the service sector (56.9%) is below the national average (66.2%). The state competitiveness is, therefore, driven by its natural resources, reflecting its status as a factor-driven economy. Veracruz also competes to a limited degree on the basis of production processes and increased product quality and has some features of an efficiency-driven economy.²

The industrial sector makes a significant contribution to the state economy of Veracruz, but offers limited employment opportunities. Despite the difference in terms of GDP between the primary sector (5.3%) and the

industrial sector (37.8%), more people work in primary sector – agriculture, livestock and fishing – (23%) than in manufacturing and construction (20.6%). Veracruz has low labour productivity and economic dependency on the natural resources (see Table 1.3.)

Table 1.2. Veracruz: Economy by sectors

Sectors	Veracruz	Mexico
Agriculture, livestock, hunting, fishing	5.3	3.6
Manufactory, building, mining oil	37.8	30.2
Services commerce	56.9	66.2

Source: INEGI (2010b), Perspectiva estadística Veracruz. (Veracruz Statistics), from INEGI: www.inegi.org.mx/est/contenidos/espanol/sistemas/perspectivas/perspectiva-ver.pdf, accessed 21 September 2010.

Table 1.3. Share of employed population, by economic sector (in percent)

Veracruz, 2009

	Primary	Secondary	Tertiary
State of Veracruz	22.9	20.6	56.3
Veracruz metropolitan area	00.9	19.2	79.4
National	12.8	24.3	62.2

Source: INEGI (2010b), Perspectiva estadística Veracruz. (Veracruz Statistics), from INEGI: www.inegi.org.mx/est/contenidos/espanol/sistemas/perspectivas/perspectiva-ver.pdf, accessed 21 September 2010.

Table 1.4. Share of employed population, by size of economic unit (in percent)

Mexico and the state of Veracruz, 2009

	Veracruz	Mexico
Agricultural sector	22.90	12.80
No agricultural sector	73.40	85.10
Micro-enterprise	54.10	48.90
Small enterprise	13.80	17.80
Medium enterprise	8.20	11.50
Large enterprise	10.90	9.70
Government sector	5.20	6.00
Other	0.80	6.14
Non-specified	3.7	2.1

Source: INEGI (2010b), Perspectiva estadística Veracruz. (Veracruz Statistics), from INEGI: www.inegi.org.mx/est/contenidos/espanol/sistemas/perspectivas/perspectiva-ver.pdf, accessed 21 September 2010.

Veracruz's main industries are electricity production; oil and gas extraction; oil and carbon derivatives manufacturing; chemistry of basic products; basic metals production; food; candy and chocolate; beverages; and tobacco. The natural resource-based in Veracruz are largely made up of branch plants which are controlled by firms from outside the state. Majority of the population, almost three-quarters, are employed in micro, small and medium-sized enterprises, which traditionally have low absorptive capacity in terms of innovation (see Table 1.4.).

The 2005-10 Veracruz's Development Plan (Gobierno del Estado de Veracruz, 2005b) is promoting the following strategic projects: tourism (development of the Riviera Veracruzana), development of world-class ports (Coatzacoalcas, Veracruz and Tuxpan), integration of ports with industrial developments, road infrastructure, airport modernisation, agro-industrial exports (floriculture), and the development of high-tech manufacturing and productive chains.

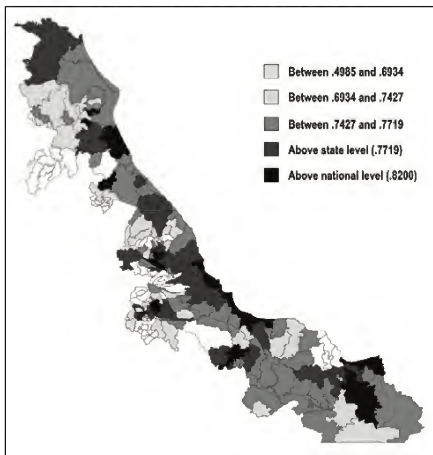
Poverty and social exclusion

Veracruz ranks as a "lagging and under-performing region" within Mexico. The state income levels are lower than the OECD mean. Its economic growth is slower than the OECD average and also diverging from the national average (OECD, 2009b). Reports on regional competitiveness rank Veracruz between 22nd and 29th (out of 32 places), depending on their methodological approach.³

A high percentage of the population in Veracruz live in various degrees of poverty, despite the progress made since 2000. By 2006, 50.8% of the state population suffered from some form of poverty, compared to the national rate of 42.6%. Furthermore, Veracruz also has a high degree of social exclusion.⁴ Veracruz's levels of inequality are high by international standards but less so compared to Latin American levels (World Bank, 2002). Poverty is present in every region of Veracruz but tends to be highest in rural areas.

Despite the improvements over time, in terms of the UNDP HDI (Human Development Index)⁵ that combines life expectancy, education attainment and per capita income, Veracruz continues to under-perform. In 2005, Veracruz ranked number 28 (out of 32) in Mexico with the value of 0.7719, compared to the national average of 0.8200 (UNDP, 2009). Only 45 out of the 212 municipalities (21.2%) have HDI scores above the state value (0.7719) while 24 municipalities (10.4%) are above the national value (0.8200) (see Figure 1.3.). Most of the state is substantially below the national average and some peripheral regions are significantly below the state average.

Figure 1.3. Human development index map of Veracruz

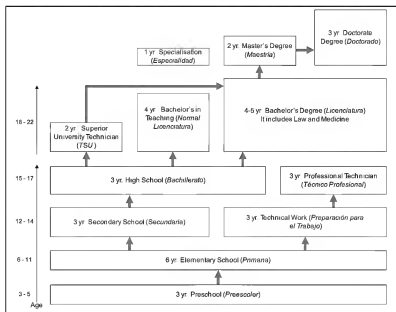


Source: Own elaboration with data from UNDP (United Nations Development Program) (2009), *Indicadores de Desarrollo Humano y Género en México 2000-2005* (Selected indicators on Human Development and Gender in Mexico), UNDP, Mexico City.

1.3 Education in Mexico

According to the 2007-12 Sectoral Plan of Education, general education policies are divided into three levels: basic, upper secondary and tertiary education (see Figure 1.4. for educational system in Mexico). The strategies and programmes of basic, upper secondary and tertiary education are co-ordinated by the Ministry of Public Education (Secretaría de Educación Pública, SEP). Policies for science and technology are designed and co-ordinated through the National Council for Science and Technology (Consejo Nacional de Ciencia y Tecnología, CONACYT) and are outlined in the 2008-12 Special Programme for Science, Technology and Innovation.

Figure 1.4. Educational system in Mexico



Source: Elaborated with information from the Mexican Ministry of Education

In 2008/09, there were 33.7 million students enrolled in the entire educational system in Mexico. Since 1991, Mexico has increased enrolment rates in basic education, upper secondary and tertiary education. In 2008, the Mexican enrolment rate for the population aged 5 to 14 years was 103.4%. However, the enrolment rate for the population aged 15 to 19 years was

51.6% compared to the OECD average of 81.5% (OECD, 2010a).⁶ The average years in formal education were only 8.1. Illiteracy is still common: among the population of 15-years-or-older, the illiteracy rate was 8.4%.

The low performance of Mexican students on international tests such as PISA, OECD's Programme for International Student Assessment, indicates an insufficient level of quality and relevance of education and is a major national concern. PISA examines, through tests and surveys of 15-year-olds, how well national systems equip their young people with key skills. According to PISA results, Mexican students are two to three years behind the OECD average. Approximately half of them do not reach basic competences in mathematics, reading and sciences that are essential to acquire the generic and specific competencies required to succeed in further academic and professional life. The results of PISA in 2006 that measure the science performance of 15-year-olds, Mexican performance was the lowest in the OECD area: Mexico obtained 410 points in science, 410 in reading and 406 in mathematics, as compared to the OECD average of 500, 492 and 498, respectively (OECD, 2007).

Another area of concern is the lack of resourcing primary and secondary education. Despite the large proportion of public spending on education (21.7% compared to the OECD average of 13.3%), the annual public expenditure on education per student is low particularly in pre-primary and basic education. This has implications for learning outcomes, as indicated by Mexico's weak performance in PISA. Total expenditure on basic education is 3.3% of GDP, compared with the OECD average of 3.5% and 2.9% for Germany, 3.7% for USA, 2.5% for Japan, 4.0% for Brazil and 3.3% for Chile. However, the Mexico's low performance rates show a low level of efficiency in public expenditure (OECD, 2010a).

As a result, Mexico faces serious challenges to obtain the skilled work force, scientists, engineers and sophisticated technological workers that are required to move towards a knowledge-based economy in the medium and long term.⁷

Tertiary education

During recent decades, the Mexican tertiary education system has achieved a degree of differentiation. There is now a wide range of different types of tertiary education institutions: public federal institutions, public state universities, public technological institutes, public technological universities, public polytechnic universities and public intercultural universities. In addition, there are public teacher education institutions, private tertiary education institutions and public research centres.

Currently, Mexico has 1 892 tertiary education institutions, of which 50 are federal and state institutions, 289 are technological institutions, 4 are intercultural universities, 995 are private institutions and 27 are public research centres. Around a third of students attend private HEIs. Majority of enrolment, 94.3%, is at the *licenciatura* level (bachelor's degree) and only 5.7% undertake graduate studies.

Mexico's diverse range of tertiary education institutions, in terms of both their mission and funding structure, has implications for the ability to engage in regional development. The traditional public universities, which train almost half of the tertiary student population, are reported to have difficulties in meeting local labour market demands. Technical universities have, however, been more successful in linking with the business sector (OECD, 2009a).

In terms of governance, there are three types of institutions (see also Table A.1.1 in the Annex for more details):

- Public autonomous universities. These can be federal or state level universities that have self governance. In most cases, autonomous universities offer both graduate and undergraduate programmes. In some cases, these institutions also offer a high school diploma. Federal public universities are funded by the federal government while autonomous state public universities receive mixed public funding from both the federal and the state governments.
- Federally or state-controlled institutions. These types of institutions include federal and state technological institutes, polytechnic universities, intercultural universities, teacher training schools (Normal Schools) and two-year technological universities.
- Private institutions. These include non-profit and proprietary institutions, which range from universities and technological institutes to teacher training schools and specialised schools. Private tertiary education institutions attracted nearly 32% undergraduate and 42% of postgraduate students in 2006. The proportion of students attending private tertiary education institutions has increased from 18.5% of the undergraduate total in 1990 to 32% in 2006 (OECD, 2008a).

Academic programmes offered in Mexico include:

- Undergraduate programmes including 2-year *Técnico Superior Universitario*, TSU (which is somewhat equivalent to the US Associate Degree), 4-year *Licenciatura* degree in Education, and

4-5 year *Licenciatura* degree in most of the academic disciplines and professions.

- Graduate programmes including *Especialización* (1 year specialisation programmes), *Maestría* (2-3 year Masters Degree) and *Doctorado* (3-4 year Doctorate).

The majority of professors (54%) are appointed on an hourly basis, and 38.5% are full-time faculty members. In the private institutions, 83.9% are appointed by the hour and only 10.2% are full-time professors. With respect to qualifications, the majority of professors (56.3%) have a *licenciatura* degree (55.1% in public tertiary education institutions, and 58.2% in private tertiary education institutions), 33.5% have Master's degrees, 1.5% specialties, and only 8.3% doctoral degrees (9.8% in the public tertiary education institutions and 5.9% of the private sector).⁸

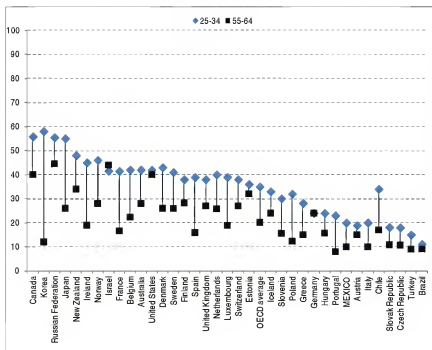
Tertiary education attainment and enrolment

The last 20 years have been a period of reform and modernisation for tertiary education in Mexico. A major achievement has been the increase in enrolment, which has increased from 1.25 million students in 1990 to 2.7 million in 2008/09. Despite this increase, the net entry rate into Tertiary-type A education is 34%, considerably below the OECD average of 56% (OECD 2010a).

In 2008, 16% of the population in Mexico aged 25-64 had a tertiary education degree compared to the OECD average of 28% (see Figure 1.5.). Mexico is ranked 26th among the OECD countries in the rate of postsecondary attainment among adults 25-64 (OECD, 2010a). However, over the last half century, participation in tertiary education has increased significantly, from 1% to one-quarter of the 19-23 age group.. The completion rate for undergraduate degree programmes in 2008 was 58%, compared to the OECD average of 69% (OECD, 2010a).

Figure 1.5. OECD Population with at least tertiary education (2008)

Percentage, by age group



Note 1: Countries are ranked in descending order of the percentage of 25-34 year-olds who have attained at least tertiary education. The year of reference for Chile is 2002 and for the Russian Federation is 2004.

Note 2: For technical reasons, these figures use Israel's official statistics, which include data relating to the Golan Heights, East Jerusalem and Israeli settlements in the West Bank.

Source: OECD (2010a), *Education at a Glance 2010*, OECD, Paris.

 StatLink: <http://dx.doi.org/10.1787/888932310092>

While impressive growth has been made in tertiary qualifications during the last decades, rising from 10% among 55-64 year-olds to 20% among 25-34 year-olds, Mexico remains among the lowest achievers in the OECD area (OECD, 2010a). This trend is strengthened by Mexico's increasing entry rates to tertiary education.

The proportion of Mexico's age cohort entering tertiary-type A programmes increased from 27% in 2000 to 34% in 2008. Mexico also compares favourably to other OECD countries in terms of the proportion of graduates gaining degrees in science and engineering. However, vocational tertiary education (tertiary-type B programmes) which provides practical and technical skills that can enhance the performance of Mexican enterprises requires attention: during the last two decades these programmes had an entry rate of 2%, compared to the OECD average of 15% (OECD, 2010a).

Most of the student enrolment is in social sciences and administration, totalling 44% since it includes the three *licenciaturas* of major enrolment: law (with 10.12%), administration (with 8.72%) and accounting (with 6.67%). The concentration of people in areas that offer very few professional degrees is a cause of underemployment and unemployment (Tuirán, 2009). On the other hand, in engineering, technology, and natural and exact sciences, fields with major impacts on development and innovation, the enrolment rate is 30.6%. Enrolment in the rest of the areas is dispersed: 8.8% of students are in health, 14.4% in education and humanities and 2.2% in agricultural sciences. In comparison, in South Korea, a newly developed country, the enrolment rate is 20% in social sciences, business and law, but 41% in sciences and engineering. In contrast, Great Britain, a consolidated developed country has a more balanced enrolment: 27% in social sciences, business and law and 22% in science and engineering.

Funding and governance of the tertiary education system

Mexico has introduced the principle of cost-sharing between government and individual beneficiaries of tertiary education, but the tertiary education system continues to rely heavily on public funding. Furthermore, Mexico has the largest gap among the OECD countries between per-student expenditure for tertiary education (USD 6 971) and for lower levels of education (USD 2 236 for secondary education, USD 2 111 for primary education). The per-student expenditure for tertiary education is 3.22 times that of the primary education. As a result, there is growing pressure to shift resources from tertiary education to school education (OECD, 2010a).

National tertiary education policy in Mexico focuses on access and quality but offers limited formal incentives for regional engagement. According to the Tertiary Education Co-ordination Law, the Federal Government promotes tertiary education through: resources, evaluation, support of agreements between national and sub-national levels, by encouraging and co-ordinating tertiary education planning. The Ministry of Public Education (SEP) is responsible for supporting evaluation, quality,

statistics collection, administration of several tertiary education funds and co-ordination across institutions and with states. There is a goal of co-ordinating between federal and state levels to support tertiary education, and national policy can encourage state action. There is, however, no mandate or policy initiative out of the Ministry of Public Education on regional engagement beyond the encouragement of the State Commission for Tertiary Education Planning (COEPES).

Most reforms have been made through a set of public policies oriented towards quality assessment and accreditation, as well as national programmes dedicated to the improvement of quality. These programmes grant scholarships to professors for postgraduate studies and postdoctoral research and provide funds to tertiary education institutions to improve physical plants and ICTs infrastructure. Quality assessment for programmes is made by the Inter-Institutional Committees for Tertiary Education Assessment (CIEES), an independent peer review organisation. Accreditation is carried out by the Council for the Accreditation of Tertiary Education (COPAES), a non-governmental body recognised by the Ministry of Public Education. Student evaluation is made through standardised examinations applied by the National Centre for Tertiary Education Assessment (CENEVAL).⁹

1.4 Education in Veracruz

Low skilled population

There are 2.3 million students in the state of Veracruz, at all levels of education, representing 6.9% of the national total. Educational outcomes remain below the national average and the state is characterised by a low skilled population. The average years of schooling are 7.2 years, compared to the national average of 8.1.¹⁰ The average years of schooling of the economically active population are 8.1 years, compared to 9.1 nationally. Illiteracy rate is high at 13.4%, compared to the national rate of 8.4%.

Total enrolment in education in Veracruz is distributed as follows: basic education accounts for 73.5%, upper secondary education 12%, tertiary education 7.5% and other programmes 7%.¹¹ Tertiary education enrolment rate (28.9%) is lower than the national average (29.1%) (see Table 1.5).

Table 1.5. Enrolment rates in Veracruz and Mexico by level of education (2008)

	Age range	Veracruz	Mexico
Primary and lower secondary	4-15	97.8	100.8
Upper secondary	16-18	63.8	64.4
Tertiary	19-23	28.4	29.1

Source: Gobierno de los Estados Unidos Mexicanos (Government of the United States of Mexico) (2010), “Cuarto Informe de Gobierno” (Fourth Governmental Report), México City, <http://cuarto.informe.calderon.presidencia.gob.mx/anexo-estadistico/>

There are significant differences between transition, drop-out and completion rates in primary and upper secondary education (see Table 1.6.). The state has significantly better performance in upper secondary education than the national average. While primary education completion rate in Veracruz ranks 26th and secondary education 19th in national comparison among different states, in terms of the completion rate in upper secondary education Veracruz comes 5th. Nevertheless, in terms of the absorption rate of secondary students into tertiary education institutions Veracruz is among the poorest performers in Mexico (30th). In order to increase enrolment rates and efficiency in education the reasons for these differences should be identified and addressed.

Table 1.6. Transition, drop-out and completion rates by level of education

	Transition		Drop-out		Completion	
	Veracruz	Mexico	Veracruz	Mexico	Veracruz	Mexico
Primary			1.1	1.6	93.8	93.8
Secondary	95.5	94.4	6.5	6.8	81.6	80.9
Technological middle	4.0	9.9	17.2	23.2	59.6	46.0
Upper secondary	90.3	86.9	12.8	15.0	67.1	67.1
Tertiary	54.7	74.4				

Source: INEGI (2010b), Perspectiva estadística Veracruz. (Veracruz Statistics), from INEGI: www.inegi.org.mx/est/contenidos/espanol/sistemas/perspectivas/perspectiva-ver.pdf?, accessed 20 September 2010. Gobierno del Estado de Veracruz (Government of the State of Veracruz) (2009a), “V informe de Gobierno Apéndice Estadístico” (Fifth Governmental Report Statistical Appendix), Xalapa, www.veracruz.gob.mx.

Only 26.8% of the potential active population¹² has upper secondary education or tertiary education, compared to the national average of 32.1%. Hence 72.1% of the Veracruz population of 15-years-or-older have not completed tertiary education (12.9%) or have completed only a secondary

education or less (59.2%).¹³ The low levels of education attainment have a negative impact on the competitiveness of the state economy (see Table 1.7.).

Table 1.7. Share of 15–64 year-olds by level of education in Veracruz and Mexico

	Veracruz	Mexico
No instruction at all	12.9	8.4
Incomplete primary school	19.6	14.3
Complete primary school	17.8	17.7
Secondary school	21.8	26
Upper secondary school and tertiary education	26.8	32.1
Total	100	100

Source: INEGI (2009), “Perspectiva estadística Veracruz” (Veracruz Statistics), www.inegi.org.mx/est/contenidos/espanol/sistemas/perspectivas/perspectiva-ver.pdg? p. 35, accessed 14 September 2010.

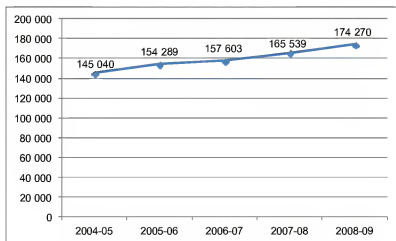
Veracruz lags behind the national averages in human capital development partly because of the high geographic dispersion of the population. Opportunities for basic (67.05%), upper secondary and tertiary education (77.65%) concentrate in urban areas such as Olmeca, Sotavento, Las Montañas, Capital and Totonaca. In contrast, the study opportunities are more limited in regions such as Huasteca Baja, Papaloapan, Huasteca Alta, Nautla and Los Tuxtlas. Illiteracy is also higher in regions which lack metropolitan areas, underscoring the importance of education in economic development.

Tertiary education major features

Veracruz’s tertiary education system is in the process of expansion, following the national trend. In 2009, there were 174 270 students, 91.8% of which were undergraduate and 5.4% graduate.

Figure 1.6. Tertiary education enrolment

State of Veracruz, 2004-09



Source: Gobierno del Estado de Veracruz (Government of the State of Veracruz) (2009b), “Veracruz en el concierto nacional. Número de Institutos Tecnológicos descentralizados” (Veracruz in the National Agreement, Number of Decentralised Technological Institutes), Xalapa. www.veracruz.gob.mx. p. 105

Tertiary education enrolment and attainment rates in Veracruz remain below the national average. The state tertiary education transition rate for 2008-09 was 72.6%, compared to the national average of 74.4%. A third of the students who completed upper secondary education did not enrol in tertiary education.

In 2008-09, the enrolment rate of Veracruz’s tertiary education was 23.5%, below the national average of 27.6%. This rate is also below the Latin American average of 34% and the OECD average of 57%. Veracruz’s tertiary education completion rate is 61%, lower than the national average of 67.8%, and its graduation rate is 36.5% compared to the national average of 48.3%.

In Veracruz, 67.5% of students attend public institutions, while the remaining 32.5% attend private institutions, of which 9 are medium-size private universities and 52 are small-size institutions. The leading tertiary education institution in the state is the Universidad Veracruzana, a public research and comprehensive university that accounts for 36.5% of the total state enrolment (53 634 students). The technological tertiary education

sector in the state consists of 3 technological universities, 1 polytechnic university, 6 federal technological institutes and 21 state technological institutes. (see Table 1.8.).

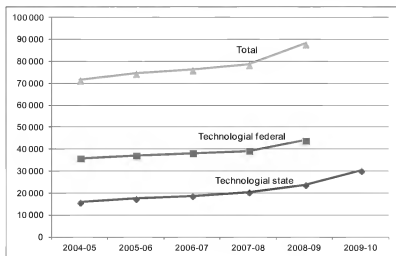
Table 1.8. Share of tertiary education enrolment, by type of institution (2007)

	Veracruz	Mexico
Public HEIs	67.5 ¹	67.3
Universidad Veracruzana	36.5	
Technological HEIs	31.0	31.8
3 technological universities		
1 polytechnic university		
21 technological institutes		
6 federal technological institutes		
Private HEIs	32.5	32.7
9 medium-size universities		
52 small-size institutions		
Total	100.0	100.0
Enrolment	174 270	

1. Includes teacher's *licenciatura* programmes

Source: Gobierno del Estado de Veracruz (Government of the State of Veracruz) (2009c), “V Informe de Gobierno Anexo Estadístico” (Fifth Governmental Report Statistical Annex), Xalapa, www.veracruz.gob.mx; Gobierno del Estado de Veracruz (Government of the State of Veracruz) (2009b), “Veracruz en el concierto nacional. Número de Institutos Tecnológicos descentralizados” (Veracruz in the National Agreement. Number of Decentralised Technological Institutes), Xalapa. www.veracruz.gob.mx; ANUIES (Asociación Nacional de Universidades e Instituciones de Educación Superior) (National Association of Universities and Tertiary Educational Institutions) (2006), “Consolidación y avance de la educación superior en México. Elementos de Diagnóstico y Propuestas” (Consolidation and progress of the Higher Education in México. Diagnostic elements and proposals), ANUIES, Mexico City p.34.

Veracruz holds the first place nationally in the number of state technological institutes, with 43 967 students representing 31% of the total enrolment of tertiary education institutions in Veracruz (see Figure 1.6.). The number of state technological institutions was doubled in 2005-09, receiving 10% of the national scholarships of the country. Almost 80% of the technological institutions' enrolment is in engineering programmes (see Figure 1.7.).

Figure 1.7. Technological tertiary education system enrolment in Veracruz (2004-10)

Source: Gobierno del Estado de Veracruz (Government of the State of Veracruz) (2009b), “Veracruz en el concierto nacional. Número de Institutos Tecnológicos descentralizados” (Veracruz in the National Agreement. Number of Decentralised Technological Institutes), Xalapa. www.veracruz.gob.mx.

1.5. Research and innovation in Mexico and Veracruz

In Mexico, there are almost 38 000 researchers (OECD, 2010b) distributed among tertiary education institutions (36%), governmental sector (19%), and private sector (42%; of which 2% is in the non-profit private sector). The number of researchers has considerably increased in the last two decades: in 1993, there were 14 103 researchers by 2000, 22 228 researchers and by 2006, 46 865 researchers.

Research capacity remains low in comparison to other OECD countries. The total number of researchers per thousand employees is 1.2, compared to the 7.3 OECD average (4.7 in the private sector, 2.6 in other sectors). Mexico also lags behind key Latin American countries. The same indicator for Brazil is 1.27, for Chile 2.03, and for Argentina is 2.41. Brazil has 133 266 researchers and is the leader of the continent in this respect.

In Mexico, the SNI (*Sistema Nacional de Investigadores* - National Research System) has 15 545 members in 2009. Veracruz’s current human

resources for science, technology and innovation include 410 SNI researchers. Veracruz has 1 230 students in graduate programmes supported by CONACyT, with 45% enrolled in doctoral programmes. Less than 8% of them are studying in foreign tertiary education institutions.

The Veracruz Regional Innovation System consists of the legal framework, the existing infrastructure, human capital and the financial support of the federal and state government. Science and Technology efforts in the state are co-ordinated by the state Council for Scientific Research and Technological Development (COVECYT),¹⁴ a decentralised organisation created in 2005.

COVECYT is responsible for strengthening, co-ordinating and supporting public and private actions towards the advancement of science and technology in the state. It is also in charge of evaluating the regional needs and challenges in S&T matters. The strategic planning of S&T policies and actions for 2005-10 is laid down in the Programme for Scientific and Technological Development 2005-10 (Gobierno del Estado de Veracruz, 2005c) as a complement to the State Development Plan (Gobierno del Estado de Veracruz, 2005b).

Infrastructure for developing R&D human resources includes nine public research centres and the National Registry of Scientific and Technological Institutions and Firms (RENIECYT), a network of 157 organisations engaged in S&T and innovation activities. This network includes 94 firms, 19 non-profit organisations, 27 tertiary education institutions and 17 other organisations in Veracruz, representing less than 3% of the 5 515 institutions and people involved in S&T nationally.

1.6. Tertiary education institutions in regional development

Links between tertiary education institutions and the productive sector are relatively weak in Mexico. Concerns about the limited university-industry links have been raised by the OECD (OECD, 2008a; OECD, 2009b), the World Economic Forum (WEF, 2010) and the Mexican Institute for Competitiveness (IMCO, 2009). The main contribution of tertiary education institutions to the productive sector is through: *i*) human resource and workforce development, *ii*) knowledge generation and *iii*) consultation and training services. Mexico is lagging behind in each of these areas because of the mismatch between supply (tertiary education institutions' graduates) and market demands. There is an excessive enrolment in social sciences and business, compared to relatively low rates in engineering, technology and sciences (Tuirán, 2009). There is also a lack of co-operation with private

firms despite recent efforts made by some large public federal and state universities, as well as by CONACYT public research centres.

The State of Veracruz has recognised these challenges and devised key development strategies that emphasise the role of universities and other tertiary education institutions in regional development. The objectives of the Veracruz Development Plan (Gobierno del Estado de Veracruz, 2005b) includes increasing student enrolment, improving the quality of the educational services and educational programmes and better aligning them with the needs of the state development. The state has adopted two main strategies to reach a higher economic growth rate: the promotion of productivity and competitiveness and the attraction of different types of investments. In both of these strategies tertiary education institutions can play an important role.

The State of Veracruz's Sectoral Plan for Education and Culture 2005-10 outlined a series of programmes on education, training, research, scientific development and technology transfer in order to enhance competitiveness and job creation. The co-ordination of co-operation between the educational and the productive sector is administered by the Science and Technology Council of Veracruz (COVECyT) and the Veracruz Inter-institutional Council of Education (CIVE). CIVE has produced an interesting report on the links between the education and productive sectors (Gobierno del Estado de Veracruz, 2007a).

There are positive prospects for the future. According to the state government's report (Gobierno del Estado de Veracruz, 2009b), economic growth rate for 2010 will reach 4%, in sharp contrast to the projected decrease of 6.5% in GDP for the whole country. Furthermore, the unemployment rates have remained at a lower level: by 2009 the unemployment rate of Veracruz was 2.74%, while the national rate was above 5%. These results can be attributed to Veracruz's diversified economy and its relatively low dependence on the US economy in the Mexican context. This suggests that Veracruz will not be affected by the high rates of unemployment from which Mexico will suffer over the next two years (OECD, 2009b). This presents a unique opportunity for Veracruz and its people to boost productivity and competitiveness in order to place them at the forefront of national economic and social development. Veracruz's diverse tertiary education sector can play a major role in this development.

Notes

1. Rural population is the amount of people living in communities with less than 15 000 inhabitants that are not part of a metropolitan area (Gobierno de los Estados Unidos Mexicanos, 2009, p. 484).
2. As mentioned previously, this is the framework of stages of development designed by the World Economic Forum (WEF, 2009a and b).
3. The Mexican Institute for Competitiveness (IMCO) *Mexican States' Competitiveness Index 2008-09* ranks Veracruz 2-26nd. The IMCO. *Índice de Competitividad Estatal 2010. La Caja Negra del Gasto Público*, with a new methodological approach, ranked Veracruz in 26th place. A regional Consulting *Competitiveness Index of Mexican States 2009* ranks Veracruz 28th. The World Bank Group *Doing Business in Mexico 2009* ranks Veracruz 24th.
4. The index of social exclusion is compound of the following nine indicators: % of illiteracy, % population without primary school, % of homes without drainage nor sanitary services, % persons living in homes without electricity, % of homes without pipe water, % of homes with some level of overcrowding, % of houses without floor, % of population in towns with less than 5 000 inhabitants and % of employed population earning at most two minimal salaries.
5. The Human Development Index (HDI) is an indicator of standard of living. The statistic is composed from data on life expectancy, education and per-capita GDP and is used to rank countries by level of "human development" and separate developed (high development), developing (middle development) and underdeveloped (low development) countries. HDI was introduced in the first UNDP's Human Development Report as a new way of measuring development.
6. Enrolment rates by age above 100 percent are due to the construction of the indicator, since two different data sources are used: enrolment records of the Secretariat of Public Education (SEP), and the estimates of school aged population calculated by the National Population Council (CONAPO).
7. There are many reasons for inefficiency in the education system in Mexico. These include: i) the way the federal resources are allocated, which do not take into account states' needs and performances (the vast majority of resources are used to pay salaries, leaving a very small

amount for school infrastructure, teaching materials, training and innovation), *ii*) uneven teacher quality across states, *iii*) the fact that teachers' professional advancements are not linked to performance assessments, *iv*) teaching that favours factual knowledge over the development of cognitive abilities, *v*) the low degree of school autonomy, *vi*) the absence of nationwide graduation examinations and effective competence assessment for students, despite the national tests such as ENLACE and EXCALE. ENLACE is a national test taken by all students in basic education to assess their learning of curricular contents as well as some cognitive abilities associated to them. Recently, ENLACE has been developed to include students in upper secondary school. EXCALE is a national test taken by a sample of students in third, sixth of primary school and third grade of secondary school to assess their learning on very specific disciplinary contents. Its purpose is to evaluate the entire system of education rather than assess individual outcomes. EXCALE is applied every four years to each one of the above grades.

8. Figures for 2004/05.
9. National Centre for Tertiary Education Assessment or CENEVAL (Centro Nacional para la Evaluación de la Educación Superior).
10. Veracruz occupies the 27th place out of 32 states in years of schooling (INEGI, 2009a; Gobierno de México, 2009).
11. It includes adult education, job training, special education for the handicapped, education for craftsman ship and special literacy programmes.
12. Population of 14 years old or more.
13. Data of 2005.
14. This is the official name of this organisation by the 869 Law. Nevertheless, it is known and referred to in official contexts as "Consejo Veracruzano de Ciencia y Tecnología" (COVECyT). In this report, it will be referred to as COVECyT.

Annex 1.1: US and Mexico tertiary education systems

Table A.1.1. Types of tertiary education institutions in Mexico

Institution type	No.	%	Student enrolment	%	Public subsidies	Description
Public federal universities	4	0.2	307 778	12.1	100% federal	Large public HEIs including the National University UNAM and the <i>Instituto Politécnico Nacional</i> (IPN, the main polytechnic) covering the vast majority of disciplines. Next to their teaching activities, these institutions develop a wide array of programmes and research projects aimed at generating and applying knowledge (GAK), and at expanding and promoting culture.
Public state universities	46	2.4	785 917	31.0	Split federal/state negotiated per institution	Decentralised agencies of state governments. Most of them are autonomous and tend to be the largest institutions within each state. They usually offer the vast majority of disciplines in different fields and conduct relevant research activities.
Public technological institutes	211	11.2	325 081	12.8	50% federal/50% state	Focused on engineering studies and professional studies in administrative areas. In addition to teaching activities, they develop programmes and projects aimed at GAK, and expand and promote culture. Most of these institutes are of federal nature while others are state level. The curricula are closely linked with labour market requirements and regional development, facilitating graduate access to the labour market.
Public technological universities	60	3.2	52 726	2.5	50% federal/50% state	Federal system co-ordinated from the Federal Ministry of Education since 1990 based on the French model for two-year programmes leading to certificate of university level technician. Their purpose is to ease student access to the labour market; the academic programmes are based on 70% practical and 30% theoretical curriculum; closely linked with industry. Most students are first generation in HEI (90%). Decentralised agencies of state governments, which conduct teaching activities, carry out programmes and projects aimed at GAK, and expand and promote technological services.

Table A.1.1. Types of tertiary education institutions in Mexico (continued)

Institution type	No.	%	Student enrolment	%	Public subsidies	Description
Public polytechnic universities	18	1.0	5 190	0.2	50% federal/ 50% state	Created in 2001, these universities are decentralised state government agencies. The emphasis of study programmes is based upon professional skills and on a learning-centred approach.
Public intercultural universities	4	0.2	1 281	0.05	50% federal/ 50% state	Created in 2001, these universities are decentralised agencies of the state governments, and are located in regions with high densities of indigenous population, albeit open to students of all origins. Under a cross-cultural concept, these institutions offer tertiary education options aimed mainly at satisfying the needs and intensifying the development potential of the regions they serve.
Public teacher education institutions	249	13.2	92 041	3.6	NA	These institutions offer tertiary education programmes in pre-primary, primary, bilingual intercultural primary, secondary, special, initial, technological and physical education among others for preparing and training teachers at different levels.
Private institutions (universities, institutes, centres and academics)	995	52.6	776 555	30.6	None for basic operations, eligible for programme funds	Includes universities of world-class stature as well as all other non-public institutions. In most of these institutions, teaching is the primary activity; however, the strongest also carry out activities aimed at GAK.
Private teacher education institutions	184	9.7	54 267	2.1	NA	NA
Public research centres	27	1.4	2 801	0.1	Federal funding	Their main objectives include diffusion of S&T; generating and applying knowledge in different areas; linking S&T with the productive sector to address problems and develop mechanisms and incentives that promote the contribution of the private sector to S&T activities. Co-ordination of most of the 27 centres is under the responsibility of the National Council for Science and Technology (CONACYT). Others, such as CINVESTAV (one of the main public research centres) are under supervision of sectoral ministries or affiliated with universities.
Other public institutions	94	5.0	124 609	4.9	NA	NA
Total	1 892	100	2 538 256	100		

Source: Adapted from OECD (2009c), OECD Reviews of Innovation Policy: Mexico 2009, OECD, Paris.

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Chapter 2: Contribution of tertiary education institutions to human capital development

This chapter examines how effectively the diverse tertiary education sector in Veracruz contributes to meeting the social and economic needs of the heterogeneous population in terms of opportunities to study and relevance of the skills and competencies offered. It identifies the main strengths and areas for improvement of the tertiary education system. The chapter closes with a series of recommendations on how to improve the effectiveness of the tertiary education system in order to increase the role and contribution of the institutions in regional development.

While progress has been made in widening access to tertiary education in remote rural areas, the participation levels remain low. Considerable sustained efforts are required to generate jobs, tackle illiteracy and widespread poverty, and to accelerate the transition towards a knowledge-based economy. The State of Veracruz needs to increase educational opportunities for all. Improving lifelong learning and tertiary education opportunities can also reduce migration of local populations to other states in Mexico and the United States.

The main message is that the ability to fuel local growth by cultivating relevant skills is the best guarantee that Veracruz will thrive in the future. Tertiary education institutions should work towards better alignment of their education provision with the needs of the region. They should strengthen the learning outcomes of their students and improve retention and completion rates by enhancing quality and relevance of their educational programmes. Sustained efforts are needed in re-skilling and up-skilling the population and improving its flexibility to face rapid changes in the labour market. Collaboration between tertiary education institutions and business and industry should be strengthened and encouraged.

Introduction

Revitalised federalism in Mexico has brought along the growth of tertiary education outside Mexico City. Until the 1970s, about 80% of tertiary education students were enrolled in the capital district. Currently, the metropolitan and mid-south regions account for about 40% of the total tertiary education enrolment in Mexico.

The growth of education opportunities brings considerable public and private returns. Inclusive access and success in education is essential for achieving social justice and ensuring that people have the opportunity to achieve their full potential. There is also a strong economic efficiency argument in favour of widening access. A well-educated population is a key factor for the social and economic well-being of a region. Education provides individuals with knowledge and competencies to participate effectively in a society and to break the heredity of disadvantage (OECD, 2009a).

In recent years, the State of Veracruz has made improvements in widening access to education. Despite the progress made, the education participation rates and outcomes remain at a low level. Furthermore, the state has high levels of poverty and social exclusion and continues to lose its human capital, albeit at a lower lever than some other states. Universities and other tertiary education institutions can contribute to the human capital development in Veracruz basically in four different ways, by:

- Widening access to and success in tertiary education of the existing youth and adult population of the region.
- Attracting talent to the region, including students and highly qualified faculty and researchers.
- Producing graduates with knowledge/skills relevant to the region's economy.
- Contributing to developing an economy that will employ graduates and retain and attract educated population.

Human capital is critical to regional development also because individuals with higher level skills are more productive. Furthermore, individual workers are more productive in regions where their peers have high levels of educational attainment.

In this context, this chapter examines the following three dimensions to assess the effectiveness and coherence of human capital development policies in the State of Veracruz:

- Do the existing tertiary education providers offer adequate learning and training opportunities to the local population in terms of age, gender and socio-economic and ethnic backgrounds?
- Are existing tertiary education institutions and their programmes adequately aligned with the skill needs of the local economy and do they support entrepreneurship in the region?
- What lessons can be learned from international experience?

Tertiary education providers in Veracruz

In 2009, there were 145 tertiary education institutions in Veracruz: 105 private institutions, 21 state technological institutes, 6 federal technological institutes, 3 technological universities, 1 polytechnic university federal institutions and 1 autonomous university, the Universidad Veracruzana, the largest tertiary education institution in the state.

The tertiary education enrolment rate in Veracruz grew by 15.8% from 2003 to 2008. In 2008-09, there were about 175 000 students in the tertiary education institutions in Veracruz. About half of the students come from the neighbouring states, which signals the attractiveness of the Veracruz education, but also highlights the underlying supply-demand problem. Approximately 53 000 were studying at the undergraduate level at the Universidad Veracruzana.

The Veracruz's undergraduate enrolment by field of study shows several variations with respect to national averages (see Table 2.1.). The enrolment of students in social sciences and administration (37.8%) is lower than the national average (46.3%), while in education and humanities (15%) it is higher than the country average. The undergraduate enrolment rate in natural and exact sciences (1%) is smaller than the national rate (2.2%). Furthermore, the enrolment in medicine and health sciences in Veracruz (7.3%) is below the national average (9.4%). However, the Veracruz enrolment rate for sciences and engineering programmes is about 36%, which compares favourably with the national rate of 33.2%, reflecting the recent investments in technological education.

Table 2.1. State of Veracruz's undergraduate education enrolment by area of studies 2007-08

Area of study	Veracruz		National %
	No.	%	
Social sciences and administration	60 533	37.8	46.3
Engineering and technology	57 599	36.0	33.2
Education and humanities	24 719	15.0	6.4
Medicine and health sciences	11 617	7.3	9.4
Agricultural sciences	3 379	2.1	2.5
Natural and exact sciences	2 172	1.35	2.2
Total undergraduate enrolment	160 019	100	100

Source: Gobierno del Estado de Veracruz (Government of the State of Veracruz) (2009a), "V Informe de Gobierno Anexo Estadístico" (Fifth Governmental Report Statistical Annex), Xalapa, www.veracruz.gob.mx; Tuirán, R. (2009), "Desafíos de la Educación Superior" (Higher Education Challenges), Presentation in the "Simposio sobre Educación Superior, X Congreso Mexicano de Investigación Educativa (COMIE)" (Symposium on Higher Education, Tenth Mexican Congress of Educational Research), SEP, Mexico City.

The leading tertiary education institution in the State of Veracruz is the Universidad Veracruzana. It is a public research-based comprehensive university that constitutes 31.3% of the total state enrolment in tertiary education (53 634 students). Of these students, 97% (51 995 students) are enrolled in undergraduate programmes with 2% (1 167 students) in postgraduate studies. The university offers 219 academic programmes 145 undergraduate and 63 postgraduate taught by 4 870 professors, 241 of whom are researchers in the National System of Researchers (SNI).¹

The Universidad Veracruzana has a significant regional presence in 27 municipalities through five campuses in Xalapa, Veracruz-Boca del Río, Orizaba-Córdoba, Poza Rica-Tuxpan and in Coatzacoalcas-Minatitlán.

The State of Veracruz has a strong technological education sector whose objective is to carry out teaching and research for the economic and social development of the region. The technological tertiary education system consists of 3 technological universities, 1 polytechnic university, 6 federal technological institutes and 21 state technological institutes. Technological institutes play an important role in building skilled human capital, mainly engineers and technicians that the state needs in order to raise its competitiveness. They also widen access to education in remote and rural areas.

The State of Veracruz has made consistent efforts to increase the importance of the technological tertiary education system. These investments have already yielded positive results. The expansion of the technological education has been rapid: 16 of these institutes were created during the present decade and today Veracruz has the highest number of technological institutes in Mexico and the largest enrolment in state-controlled technological education nationally. 43 967 students studying at the state-controlled technological institutes account for one fourth of the total tertiary education enrolment. About 50% of scholarships assigned to the state are channelled to technological tertiary education institutions. Almost 80% of technological institutes' enrolment is in engineering programmes. Around 63% of technological institutes' graduates find employment within the first year of them entering the labour market, albeit there are indications that the graduate unemployment rate is high and a large share of the graduates leave Veracruz after graduation. The technological institutes have created 366 strategic alliances with the regional stakeholders in business and society and are increasingly involved with international partners and projects, which can in time provide strong assets for enhancing international competitiveness of the State of Veracruz. In order to co-ordinate and promote the international efforts in the higher education sector in Veracruz, it is recommended that an international office is established at state government level (within the Veracruz Ministry of Education). This measure would enhance the international competitiveness of Veracruz.

Table 2.2. Veracruz technological tertiary education system enrolment

	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
Technological State	15 977	17 519	18 809	20 390	23 808	30 362
Technological Federal ¹	19 808	19 714	19 325	18 869	20 159	N/A
Total	35 785	37 233	38 134	39 259	43 967	

1. Data for 2009/10 not available yet.

Source: Gobierno del Estado de Veracruz (Government of the State of Veracruz) (2009b), "Veracruz en el Concierto Nacional, Número de Institutos Tecnológicos Descentralizados" (Veracruz in the National Agreement. Number of Decentralised Technological Institutes), Xalapa. www.veracruz.gob.mx.

Part of the expansion of tertiary education can be attributed to the private tertiary education institutions. In 2003-08, the number of private tertiary education institutions in Veracruz increased from 55 to 102. In 2007/08, these institutions represented 36.8% of the state's enrolment

(55 995 students). While the state's tertiary education enrolment rate from 2003 to 2008 grew by 15.8%, private universities' growth was 18.6%.

2.1 Regional demographics and human capital development

The State of Veracruz has a population of about 7.1 million which is dominated by people with low skills. Over the last decade population growth in the region has been significantly less than the national average. This is due to the negative migration balance: Veracruz is a net exporter of population to other regions of Mexico and the United States, albeit at a lower rate than many other states. It loses both highly-skilled and low skilled population. This is a consequence of relatively limited economic opportunities for young adults, causing significant numbers to migrate to other regions of Mexico in search of employment.

Certain demographic characteristics of the region have implications for human capital development. These include high poverty rates, ethnic diversity and geographically dispersed population. Half of the population (50.8%) of the population is classified as poor, compared to a national average of 42.6%. An increase in educational attainment is associated with reduced poverty rates in Mexico, also in Veracruz. It is likely that improvements in educational attainment would produce further reductions in rates of poverty.

The State of Veracruz is ethnically diverse. It has the third largest indigenous population in Mexico and 10% of the population speak an indigenous language. While there have been some improvements in socio-economic and educational conditions of these groups in recent years, they continue to lag non-indigenous Mexicans. Improvement in the socio-economic conditions of indigenous peoples is closely tied to the successful implementation of education, labour force and rural development strategies.

Finally, Veracruz features wide intra-regional disparities in socio-economic outcomes and connectivity. The population is geographically dispersed and a large number of people live in peripheral and mountainous areas with limited access to services.

2.2 Tertiary education participation

The human capital development of Veracruz is closely aligned with the production of the region's tertiary education institutions. Increases in tertiary education opportunities, tertiary education participation and the addition of numbers of tertiary education graduates to the regional population contribute

to the region's economic, social and cultural development. The challenge is to continue and improve the participation rates and to better align the education system with the region's needs.

Mexico has made progress in diversifying its tertiary education system, which allows catering for the needs of an increasingly diversified student population. Over the past five years, tertiary education enrolment in Veracruz increased almost by 16% reaching close to 175 000 students today. A major factor driving the growth in participation has been the expansion of the capacity of the regional tertiary education system. This has been achieved mainly through the opening of new institutions, but to some extent also through the expansion of the existing institutions. Hence three types of institutions have played an important role in widening access: *i*) the technological education institutions, *ii*) the Universidad Veracruzana through its Universidad Veracruzana Intercultural (Intercultural University of Veracruz) that is reaching out to remote and rural areas and *iii*) a large number private universities, which focus on specific market niches.

The technical education sector in Veracruz has gone through a significant expansion and is beginning to play a more meaningful role in the regional human capital development system. The state ranks No. 1 nationally in the number of technological institutes (21), above the State of Mexico and the Federal District, both regions which have considerably larger populations than Veracruz. There has been a 50% increase in students being trained in the decentralised technological institutes in the last five years, indicating that there is a growing market for practice-oriented degree programmes. While the technological institutes are centrally administered, they have some degree of flexibility in the composition of the programmes which allows them to serve the needs of the local population. The sector plays an important role in widening access also because it mainly serves first generation students: For instance, seven out of ten students attending the Technological University of Central Veracruz are the first in their families to attend tertiary education. Moreover, a key factor in the enrolment for many students has been the availability of a technological institute close to their home, otherwise in remote and rural areas attendance at tertiary education institutes would be difficult.

Another important achievement in the State of Veracruz has been the creation of the Universidad Veracruzana Intercultural (Intercultural University of Veracruz) by the Universidad Veracruzana at the initiative of the Ministry of Public Education. The Intercultural University of Veracruz has four satellite campuses (Huasteca, Totonacapan, Montañas and Selvas) that reach out to remote areas and to indigenous populations (see Box 2.1.).

Box 2.1. Increasing education opportunities for the indigenous population

In 2005, Mexico had an indigenous population of roughly 6 million inhabitants (INEGI, 2006), representing around 6.7% of the population. The growth of the indigenous population in 2000-05 was 0.6%. Veracruz has the third-largest indigenous population (605 135 inhabitants) after the states of Oaxaca and Chiapas.

In 2001, the Ministry of Public Education in Mexico established in 2001 the office for intercultural and bilingual education with the aim of providing high-quality education to the indigenous population in Mexico. In collaboration with regional partners, the office has contributed to the creation of nine intercultural universities in Mexico. These intercultural universities aim to support the development of indigenous communities. Mexico pioneered in intercultural education policies in Latin America (SEP, 2010).

In 2005, the Universidad Veracruzana (State Public University of Veracruz) launched the Universidad Veracruzana Intercultural (Intercultural University of Veracruz) programme as a way to widening access to remote, rural areas of the State of Veracruz. UVI was initially co-ordinated by the university's Institute for Educational Research. However, in 2007 the programme gained some autonomy with the creation of the Intercultural Universidad Veracruzana Directorate. In each of its four campuses, UVI offers a bachelor of arts degree programme in intercultural management for development with five minor areas (languages, communication, sustainability, law and health) and a master degree programme in intercultural education. UVI supports the University of Veracruz's mission to contribute to the social dissemination of knowledge.

UVI was launched in 2005 started with 338 students. For the 2010/11 academic year, the university has an enrolment of 2 964 students, while 388 students have graduated.

Source: Universidad Veracruzana (University of Veracruz) (2010), "La Universidad Veracruzana Intercultural's" (*The Intercultural University of Veracruz's*) website, www.uv.mx/uvi, accessed 28 June 2010.

While progress has been made by Veracruz tertiary education system in expanding opportunity, significant challenges remain both in consolidating the gains that have been made and continuing and accelerating the progress. The current tertiary education enrolment rate (25.1%) is below than the national average (27.6%) and the OECD average of 57%, the overall educational attainment levels remain low and the adult illiteracy rate is high

at 13.7%, compared to 8.7% nationally. Veracruz needs to do more to widen access and increase education attainment at all levels. Two challenges in tertiary education have to be addressed in this context: *i)* the transition from upper secondary education to tertiary education; and *ii)* the graduation/progression at the tertiary education level.

Access to tertiary education is largely determined by outcomes in preceding levels of education. A major weakness in the Mexican system is the low completion rate in upper secondary education. Within the OECD area, in 2008, Mexico had the second lowest percentage of upper secondary attainment, with 34% against an OECD average of 710% (OECD, 2010a). Furthermore the learning outcomes of the 15-olds are at a low level. The authorities in the State of Veracruz have recognised the challenge of inadequate preparation at primary and secondary education and have supported a number of state-wide programmes to improve the quality and relevance of education (see Box 2.2.).

Box 2.2. Improving quality and relevance of education in Veracruz

The State Government of Veracruz has since 2006 implemented in gradual stages a comprehensive programme to improve student achievements and teaching practices and to improve the quality and relevance of education in Veracruz. These include the Clavijero project, the Rébsamen centres, the Vasconcelos project and the Veracruz educational channel.

The Clavijero project is a competencies-based blended learning programme for upper-secondary and tertiary education.

The Rébsamen centres consist of library services with an intensive use of ICTs for improving teacher performance and providing non-conventional courses for the population.

The Vasconcelos project is a state-wide basic education programme to promote school attendance targeted socially disadvantaged communities and using mobile units (see also Box 2.1.).

The Veracruz educational channel is a programme oriented to improve teacher performance through radio, TV and the Internet. These programmes assist Veracruz to overcome its educational lag, both in terms of its position compared to other Mexican states and also the disparity that exist with the state of Veracruz, and are a lively proof of what public policies can do to help and sustain regional development.

The “Road of science” promotes the knowledge of science among school children with a help of a mobile laboratory that visits schools in Veracruz. It is stayed by university students of science and education, who expose pupils in primary and secondary education to scientific experiments.

In the last five years, Veracruz has made some progress in improving learning outcomes. One of the achievements has been the improvements in the results of the 2006 PISA, where Veracruz's performance increased by 42 points in reading, 47 in mathematics and 26 in sciences, above the national average results (see Table 2.3.) however much remains to be done in this area. The ENLACE scores in 2009 for mathematics and Spanish (state ranking 24 and 18 respectively) show the need to continue efforts in this area.

Table 2.3. Veracruz PISA 2006 results

Areas	Performance			Veracruz in Mexico	
	2003	2006	Variation	2003	2006
Reading					
Veracruz	365	407	42	26	20
National	400	411	10		
Mathematics					
Veracruz	357	404	47	26	21
National	385	406	21		
Sciences					
Veracruz	378	404	26	28	23
National	405	410	5		

Source: Gobierno del Estado de Veracruz (2008), "El Sistema Educativo de Veracruz, Xalapa" (The Educational System of Veracruz, Xalapa), www.veracruz.gob.mx.

The educational authorities need to continue to work on improving the quality of education in Veracruz and to reduce the equity gaps in basic and secondary education. Educational reform at the secondary school level is necessary in order to align secondary school graduation standards with tertiary education admission standards, to establish programmes to ensure that all primary and secondary students (and their families) get the information they need to prepare for tertiary education and to improve the preparation of teachers in the schools. Overcoming quality and equity gaps in secondary schools is not the direct responsibility of local tertiary education institutions. The primary responsibility lies with school authorities to work towards improving the quality of education in Mexico. They will need to address the challenges in a comprehensive way and mobilise appropriate levels of financial resources to support public education.

At the same time, however, universities and other tertiary education institutions can do much more to reach out to local schools to raise aspirations and academic performance of students and to improve the quality of teaching. In Veracruz, the problem of insufficient preparation is recognised by most tertiary education institutions. A recurrent concern among faculty and administrators was the deficient social skills and low competence level of students. The inadequate preparation has also impact on high dropout rates in tertiary education. As a consequence, a number of school outreach programmes have been developed by individual tertiary education institutions and/or their departments. There is, however, no information available on the success of these initiatives.

Improving access, retention and completion in tertiary education will also require improved pathways between schools and tertiary education institutions and among tertiary education institutions. For example, there are limited pathways for students to progress from technological institutes into university. The effectiveness of the education system would benefit from universities recognising courses completed by student in technological institutes as fulfilling some of the requirements for a university degree. This action would significantly help widen tertiary education access as a substantial number of students at technological institutes are from low socio-economic backgrounds.

A key issue impeding human capital development in the State of Veracruz is the absence of a region-wide mechanism to articulate a long-term vision and implement an integrated development strategy for all educational institutions. Transparent pathways for students through the education system need to be put in place. This would involve the development of credit recognition schemes, course and programme articulation agreements, increased support for joint and collaborative study programmes and clear and enforceable policies related to credit transfer between the technological institutes and universities.

Lessons from international experience: widening access in Australia and Texas, United States

A comprehensive approach to widening access to education is provided by Victoria University in Australia, whose catchment area is one of the fastest growing but poorest areas of Melbourne. The university serves a student population with a higher than average representation of students from low socio-economic and non-English speaking backgrounds. Victoria University's work demonstrates a strong commitment to collaboration across sectors. It involves both school and community partners in designing and delivering interventions to increase their relevance to particular

contexts. It builds relationships between school students and mentors, such as university students or prominent community figures. It constitutes early, long-term and sustained interventions. Some projects take a cohort-based approach to changing student attitudes and peer culture in relation to education in order to improve achievement and aspirations for future education and employment (OECD, 2010b) (see Box 2.3.)

Box 2.3. Victoria University's Access and Success programme

Victoria University is a multi-sector tertiary education institution that provides both tertiary education and technical and further education. It has over 50 000 local and international students enrolled at campuses across the city-centre and western suburbs of Melbourne. The Access and Success programme works with schools in the west of Melbourne to improve access to, and successful participation in tertiary education. It has established collaborative teaching and research partnerships with schools and has implemented programmes across more than 70 different sites. It comprises different “arms”, which involve university staff and students working in schools (Learning Enrichment), professional development of teachers via participation in post-graduate education (Teacher Leadership), working with senior secondary students to support their aspirations and provide information on pathways to tertiary education and employment (Youth Access), enhancing students’ educational engagement through school-based programmes with community partners (Schools Plus) and developing and disseminating research (Access and Success Research).

“Learning Enrichment” involves learning teams of school and university staff and students. University presence in schools improves student achievement and raises aspirations. Pre-service teachers work with in-service teachers and university researchers to design action research projects that investigate student disengagement and participate as literacy mentors in a literacy intervention, while also researching the impacts on school staff. “Teacher Leadership” engages teachers and principals in professional learning, *e.g.* by delivering professional development that articulates with the university graduate certificate or masters of education programmes. Research partnerships are based on participatory methodologies, which give teachers control over the research agenda in the schools.

Schools Plus builds school-community connections and increases the engagement of students and families with education and community life, *e.g.* the Kinda Kinder programme (launched in 2005) addresses low levels of pre-school participation by engaging with parents and children. Children attend once a week with a parent or a caregiver for one hour free programme in public libraries, other community settings and schools. Early childhood teachers provide education through storytelling and other play activities and support parents to develop social networks and familiarisation with formal education and community services. In 2009 Kinda Kinder operated in 19 sites across the western region of Melbourne.

Box 2.3. Victoria University's Access and Success programme (continued)

A new generation of adult learners including parents and grandparents are learning along with the children, the pre-service teachers and university staff in the Kinda Kinder setting. Kinda College is being developed in conjunction with the vocational tertiary education part of the university and will offer parents the opportunity to gain further education accreditation for the skills they develop.

A range of quantitative and qualitative research methodologies are used to evaluate and inform collaborations with school and community partners and to track the impact of the projects. This investment in research and the emphasis on building of community capacity through cross-sector and cross-agency partnerships has increased the reach and sustainability of the project.

Source: Gale, T., S. Sellar, S. Parker, R. Hattam, B. Comber, D. Tranter and D. Bills (2010), *Interventions Early in School as a Means to Improve Tertiary education Outcomes for Disadvantaged (Particularly Low SES) Students: Case Studies of Selected Australian University Outreach Activities*, Department of Education, Employment and Workplace Relations, Canberra; OECD (2010b), *Higher education in Regional and City Development*. State of Victoria, Australia, OECD, Paris.

Another international example underscores the need for long-term collaborative efforts to widen access and improve success in education. In El Paso, Texas over 80% of the population is self-identified as Hispanic compared to about 25% for the State of Texas. Almost three-quarters of the population speak a language other than English at home. There is a high concentration of low-income people, many with low educational attainment. When children from these households enter school they face significant challenges including: *i*) remaining in school; *ii*) learning the skills necessary to increase their employability and productivity and *iii*) obtaining a college degree. The El Paso's tertiary education institutions, under the leadership of the University of Texas at El Paso, have taken concrete measures to widen access to tertiary education. In collaboration with the public and private sector stakeholders they have formed the El Paso Collaborative for Academic Excellence and made notable progress in raising educational attainment. Underlying individual institutional efforts is the College Readiness Consortium, which connects efforts in primary and secondary education institutions in all school districts to tertiary education programmes (see Box 2.4.).

Box 2.4. El Paso: widening access by broad-based long-term co-operation

The ability of the HEIs to widen access and increase educational attainment in the region depends on preparation in primary and secondary education. The El Paso Collaborative for Academic Excellence (est. 1991) is a multi-stakeholder public-private effort to improve educational attainment and retention from the first year in school through college or university programmes. The collaborative has members from the business community, all levels of educational institutions, the public sector and NGOs. The goal is to make systematic changes in educational policy and curriculum in all of the 12 El Paso County School Districts to produce measurable results in performance and bridge the gap between ethnic and socio-economic groups.

The approach has been successful in improving the performance of Hispanic students, which make up the largest proportion of low-income students and for whom English is usually a second language. Test results for Hispanic students in the 11th grade (a year before college entry) show improvement from the 33rd percentile in 1993 to the 72nd percentile in 2008. Hispanic students show increases in enrolment in science, technology, engineering and mathematics, and a graduation rate of 76.7%, the highest among school districts in the State of Texas. Hispanic students make up 89% of the student population in the El Paso school district. Improvement in their achievement has a significant effect on the overall performance at schools.

HEIs benefit from this collaboration. El Paso Community College (EPCC) is the primary entry point to tertiary education for low-income students. As a result of efforts to widen access and increase educational attainment, e.g. by grants to improve remedial education, enrolment rates increased by 35% and graduation rates 92% (2002-08). Programmes to increase college readiness and success in a four-year degree programme have resulted in improvements in mathematics, reading and writing measures. The percentage of students assessed as college ready improved from 35% in 2003 to 74% in 2008. EPCC's Early College High School Programme enables high school students to obtain credit for college level courses reducing the time and money needed to complete a college degree.

The University of Texas at El Paso (UTEP) benefits from better preparation for tertiary education and has undertaken its own programmes to widen access and improve completion rates. 70% of the UTEP students come from the region. UTEP has increased its enrolment by 40% since the late 1990s. The majority of the increase has been in Hispanic students (from below 40% of the student body to 75%). Degree awards have risen from about 2 000 in the late 1990s to 3 500 in 2008. About 10% of students are Mexican citizens who cross the border to attend classes at UTEP.

Box 2.4. El Paso: widening access by broad-based long-term co-operation (continued)

UTEP has made tertiary education more affordable and accessible to students who have to work to attend college, by changing course scheduling, enabling students to borrow books and paying for their education. This support is important given the low-income levels of the college age population and their households, their lack of familial experience with tertiary education, their need to combine work and study and propensity to avoid borrowing to invest in tertiary education.

Source: OECD (2010c), Higher education in Regional and City Development. The Paso del Norte Region, Mexico and the United States, OECD, Paris, www.oecd.org/dataoecd/17/61/45820961.pdf

Increasing participation of adults

Due to rapidly changing skill requirements in working life, lifelong learning, skills upgrading and re-skilling are becoming increasingly important. Upgrading the skills of the adult population is likely to have a more direct effect on the region's economic performance since adult learners are generally less mobile than younger students due to family commitments. For non-traditional learners, who combine work and study and/or family obligations, flexible ways of provision need to be in place through work-based, e-learning and distance education. In addition, attendance on the basis of non-formal and informal learning should be allowed (OECD 2007; Santiago *et al.*, 2008).

While tertiary education institutions in Veracruz are aware of the needs of the adults and have some programmes in place for them, limited robust data is available to understand the needs of this population or the efficacy of tertiary education in meeting these needs. In general, tertiary education institutions in Veracruz are more geared to serving "traditional" young learners than working age adult. Some promising steps have been made to provide basic skills for the region's low skilled population (see Box 2.5.). By making courses available to non-traditional students at night or on weekends, tertiary education institutions could serve adult learners. The Universidad Veracruzana has also computer lab to build IT literacy where training is given in Spanish and *Nahuatl* (regional language of Veracruz).

On-line courses targeted at adults are one way to reach out to adult. Monterrey Tech's Prepanet is an example of this type of initiatives, but the participation of students in Veracruz remain low. Other approaches that

have demonstrated effectiveness with adults, such as work-based programmes were not much in evidence in Veracruz (see Box 2.5.).

Box 2.5. Catering non-traditional learners

The Mexican Institute for Adult Education (INEA) aims to provide education to non-traditional learners including illiterate population above 15 year-olds, 10-14 year-olds not attending primary or secondary school, indigenous population and Mexicans living in the United States. In Veracruz, as of May 2010, INEA has graduated 536 learners from primary school (INEA, 2010). Students from tertiary education institutions support INEA's efforts by participating in the tutorship programme.

Some universities in Veracruz have also taken steps to work with adult learners. An example is the Orizaba Valley University's Senior Citizens University (UNIAM, in its Spanish acronym). This programme started in 2005 and aims to provide education to 55+ years-old persons in fields such as IT literacy, languages, arts, history. As of 2009, around 200 adults have graduated from this programme.

The Monterrey Tech's Prepanet, an upper-secondary education online platform, was created to improve educational attainment in Mexico. The programme is offered in the Monterrey Tech's campuses at low cost (usually students can apply for a scholarship). As of May 2010, there were 100 students in Veracruz (out of 4 341 in Mexico) enrolled in the Prepanet platform. Undergraduate students can take part in this programme by serving as tutors as part of their social service. (ITESM, 2010)

The difficult terrain and the dispersed population creates specific challenges for the education sector in Veracruz. In peripheral and in mountainous areas, the provision of education is particularly difficult due to the poor transport and communication infrastructure. An innovative example of how to reach out to population in remote areas is the Vasconcelos programme, initiated by the State Government of Veracruz. It provides learning opportunities in technological skills to students in the state's socially disadvantaged areas (see Box 2.6.).

Box 2.6. The Vasconcelos Programme

This programme works to empower individuals and communities in Veracruz by teaching them technological skills. As a result, a significant number of people have attained a higher level of education which improves their labour market position and provides opportunities to increase their incomes. The programme serves people from all age groups, with a special focus on public school students, who comprise one-third of the state's population.

Vasconcelos uses 24 buses to bring learning opportunities to the state's socially disadvantaged areas. These state-of-the-art mobile classrooms are equipped with laptop computers, self-directing satellite dishes with Internet connectivity, networked servers, video projectors, interactive white boards, and back-up generators. Each bus is staffed by a team of seven highly-trained people who teach technological skills, facilitate community-building activities, and maintain local technological resources. The team members, many of whom speak a local indigenous language, spend two weeks in the community teaching computer and Internet courses and updating local technology access points. There are also educational and cultural activities designed to empower students and engage them in the learning process.

Vasconcelos has provided education and support to more than 120 000 people. The programme has trained staff from 75 community technology centres. In 2008, the Vasconcelos project received the Access to Learning Award from the Bill and Melinda Gates Foundation. To meet increasing demand, Vasconcelos plans to serve more than 200 000 people with nearly 50 buses by 2010.

The Universidad Veracruzana, through its Liaison Office, provides services to support regional development. For instance, the university supports local governments in the design and implementation of local economic development agencies and in the implementation of “municipal observatories”. While most of these efforts are in an early stage of implementation, the approach is geared towards training services. There is currently limited data available to assess the impact of these efforts.

2.3 Improving the quality and relevance of education

Due the continuous outmigration from the region, the question of alignment of tertiary education to regional employment deserves attention. The inter-dependence between regional economies and tertiary education systems means that their alignment is an issue of increasing importance. This issue has received increasing attention in Veracruz, which can be seen

for instance in the growth of the technological education sector. The following conclusions can be made about the alignment of tertiary education in Veracruz to regional labour markets:

- There is limited capacity to identify labour market needs and trends on a regional basis. Most evidence about labour markets is anecdotal and/or addresses tightly focused industry sectors (e.g. agriculture) or specific companies.
- There is a lack of robust data about student progress and achievement as well as their labour market outcomes (e.g. employment after graduation, salary and career paths) and graduate destinations (where do they find employment).
- Curricula remain career-based rather than competencies-based. There is limited participation of employers in curriculum and course design with the exception of technological institutes.

The general conclusion that can be drawn is that not enough robust data is available about regional labour markets in the State of Veracruz to fully align tertiary education programmes to regional needs. Part of the problem stems from the large number of institutions and the decentralised nature of the tertiary education system in Veracruz. These characteristics provide benefits and strengths to the system as a whole, but have a negative impact on the ability of individual institutions to address the regional labour market needs.

For instance, the information provided by the Labour Market Observatory of the Federal Ministry of Labour and Social Welfare indicates that engineering and technology related professionals represent 22.9% of the employed professionals, while enrolment in this field in tertiary education institutions in Veracruz represents 36% of students. This indicates outmigration of educated workforce from the region. There is a need to better align the tertiary education provision with the market needs. Alternative solution to this mismatch is to assist engineering and technology students in forming their own enterprises and generating their own employment.

The expanding tertiary education system faces also difficulties in terms of retention and completion. The increase in tertiary education participation has contributed to high dropout rates. The reasons for dropouts are manifold, including: *i)* insufficient preparation of incoming students, *ii)* inflexible curricula, *iii)* financial problems of students and *iv)* teacher-centred learning models. Data about dropout rates and academic progress of students is lacking at the state and institutional level. It would be recommendable to

begin collecting and analysing robust data to better understand and address the dropout problem.

Improving retention and completion in tertiary education would also require stronger academic, social and financial support for students. It was unclear to what extent tertiary education institutions have invested in support services to facilitate success in education.

Mexican tertiary education sector has been dominated by traditional academic model, with a strong teacher-centred focus and insufficient library and information-services infrastructure. In recent years, the Universidad Veracruzana has made strong efforts to address these shortcomings and to modernise its academic model (see Box 2.7.).

Box 2.7. Improving quality of education in the Universidad Veracruzana

The Universidad Veracruzana has introduced different institutional actions in recent years to reform and modernise the academic model according to international trends and guidelines.

In 1999, a new academic model was established to adapt a more student-centred approach; in 2007, the institution engaged in the CESAL-INNOVA international project financed by the European Commission which aims to improve university teaching, the professional development of students and their access to labour markets. In 2009, the AULA project was implemented to train faculty in a student-centred model.

Another institutional achievement is the establishment of an extended network of library and informative units (Unidad de Servicios Bibliotecarios y de Información, USBI) on each campus throughout the state.

Source: Universidad Veracruzana (University of Veracruz), (2008a), “Resumen del Proyecto INNOVA-CESAL” (Summary of INNOVA-CESAL project), www.uv.mx accessed 21 September 2010.

Enhancing employability

Tertiary education institutions in Mexico have, generally, limited ties with the productive sector and with industry. The weak engagement of tertiary education institutions with the private sector is an important issue in Veracruz which negatively affects industry-university relationships,

knowledge transfer and university entrepreneurship activities (see also Chapter 3).

Technological institutes that offer practice-oriented programmes in engineering-related fields and have close ties with the local productive sector in the following ways: *i*) employers participation as external members in the governing body of the institutes, *ii*) employers participate in the design of programmes and curricula, *iii*) internships in local firms are part of course requirements. Similar arrangements would benefit also the university sector, but to date appear less frequent. However, while collaboration with industry is more intense within technological institutes, they have failed to attract as much private investment as originally expected.

Universities in Veracruz are starting to use experimental and work-based learning models. Two of the most interesting examples are Veracruz enterprise brigades (*brigadas en empresas*) and the mentoring programme of the Anahuac University at Xalapa, (UAX). The Universidad Veracruzana's programme is mainly focused on students in business studies and has engaged over 7 000 students in development work in small and medium-sized enterprises. In the Anahuac University at Xalapa all students are required to work on a full-time basis during a 5-week period the mentoring programme. More than 500 students have participated in the programme since its beginning (see Box 2.8.).

Box 2.8. Work-based learning in HEIs in Veracruz

Universidad Veracruzana's enterprise brigades (*brigadas en empresas*)

Universidad Veracruzana's enterprise brigades were established in 2005 to integrate study curricula with practical experience in the business world, and to contribute to the sustainable development in Veracruz. Students are tutored by professors and integrated in an enterprise to carry out practical work, which can involve developing new products. By 2009, 295 projects have been launched, which have involved 350 academics, over 7 000 students and more than 1 600 firms, normally of very small size. These projects have primarily resulted in the production of handbooks (*e.g.* on accounting and workplace safety), market analyses and advertising campaigns for the firms consulted. Most of the students come from accounting, business administration and industrial relations departments.

Box 2.8. Work-based learning in HEIs in Veracruz (continued)

The Anahuac University at Xalapa's Mentoring Programme

The Anahuac University is a private system that comprises 16 campuses across Mexico and opened its first campus in 1968 at Mexico City. The Xalapa campus, the Anahuac University at Xalapa (UAX), began its operations in 1993 and offers 11 bachelor and 6 master programmes. In 2003, UAX launched a mentoring programme, designed to provide students with the opportunity to work in a company under the supervision of its top manager. The key aim of the programme is to expose students to real challenges faced by the companies.

The 200-hour internship is mentored by a company's top-manager. The mentoring programme is administered by the business liaison office of the university. Once a company and mentor have been selected by the student, the university signs an agreement to ensure the fulfilment of the programme's goals. Students are required to work on a full-time basis during a 5-week period. At the end of the internship, mentors submit a report about the student's performance and also provide a grade for the university. The programme is credit-bearing and compulsory for all students. More than 500 students have participated in the programme since its beginning.

The Universidad Veracruzana's enterprise brigades is an interesting initiative which exposes students to their first labour market experiences. However, to provide a basis for win-win university-industry collaboration, it would be advisable to extend the programme to graduate and PhD levels and to wider range of disciplines, beyond management and accounting departments to encompass applied-science departments. In the current form, it is not clear to which extent the enterprise brigades benefit firms, given that undergraduate students are not yet well-placed for providing business advice and consulting. Firms would benefit not only from exposure to accounting or marketing, but also from expertise in more technical fields such as engineering and information/communication technologies. Both programmes should consider the different time frames of students and business owners to allow for flexibility and increase the potential time for interaction between students and business owners.

Internationally, many universities and other tertiary education institutions are building closer, more systematic links with the world of work. In the United Kingdom, Knowledge Transfer Partnership programme (Former Teaching Company Scheme) provides a grant to cover part of the operation cost to transfer and embed knowledge into business via a strategic project and people-based mobility. SMEs represent about 90% of industry

partners (see Chapter 3). Co-op education in Canadian universities helps students to complete work terms in industry as part of their curriculum (see Box 2.10. for the University of Waterloo's experience in this area). Some universities, such as the University of Aalborg in Denmark, have also taken steps to embed employability and transferable skills in their core curriculum through problem-based learning in multidisciplinary teams (see Box 2.9.).

Box 2.9. Problem-based learning at Aalborg University

Aalborg University was established in 1974 after years of popular campaign in the region to establish a university in northern Jutland in Denmark. The campaign formed the basis for a close dialogue with the surrounding society relying on cooperation with the business sector, trade unions and cultural life. An important early decision was to base research and educational activities on interdisciplinary integration, problem orientation and group work.

In project oriented problem-based learning, study programmes are organised around interdisciplinary project work in groups. Up to 50% of the study is problem-oriented project work: student work in multidisciplinary teams to solve real-life problems which have been defined in collaboration with public and private sector and NGOs. At any one time, there are 2 000 to 3 000 ongoing projects to ensure a high degree of collaboration with the society and private sector.

The Aalborg model is based on a win-win situation: it provides students with transferable skills and authentic work experience while enterprises benefit from a clearer picture of what the university stands for and how students might fit in as prospective employees. Finally, the university gains feedback from the world of work and also benefits from access to instructive cases and ideas for research and teaching.

Source: OECD (2007), *Tertiary education and Region – Globally Competitive, Locally Engaged*, Paris, OECD, p. 157.

Box 2.10. The Co-operative Education Programme at the University of Waterloo, Canada

The Waterloo Region in Ontario, located about 100 km west of Toronto, has a the strong factor advantage of a rich local labour pool largely as a result of a strategic decision made at the inception of the University of Waterloo. The founding document for this university in the 1950s (the Waterloo Plan), called for a new type of education to be offered on a co-operative basis with industry. The rotation of students to industry and back to the classroom solidified the university's relations with local industry.

Today, the University of Waterloo has the largest co-operative education programme in the world, with over 11 000 students (60% of the student body) and 3 000 employers involved in the programme each year. Collaboration with industry encourages students to have a strong connection between their education and the area of employment that they would like to work in.

Extensive co-op programme offerings are available in all faculties and departments and in over 100 different programmes. Many of local and global firms have strong links with the co-op programme. At Sybase, an enterprise software company that spun-off from the original WATCOM Corporation, with over 250 employees in its Waterloo campus alone, 15% of its current employees are Waterloo co-op students, and more than half of their Waterloo staff is former co-op students.

The co-op programme brings a number of benefits to the local economy, *i*): it acts as a steady source of new hires, because firms know that the students have work experience, and they get an opportunity to evaluate their performance in the work place before hiring them, *ii*): students act as an important transfer mechanism for tacit knowledge and know-how; they also act as a critical source of knowledge circulation within the local high-technology cluster, effectively transferring knowledge between different firms as they undertake different placements over the course of their integrated work-study programme, *iii*): the relationship between the university and local industry allows the curriculum to keep up-to-date with the changing technological frontiers of industry while industry support of the programme funds the acquisition of technology to enhance classroom learning.

This awareness of the crucial link between commercialisation and entrepreneurialism is also underscored and supported by the Enterprise Co-op Programme, which enables students to start their own venture instead of doing a co-op placement with an established firm, and focuses on creating a local network of contacts and mentors to support it.

Box 2.10. The Co-operative Education Programme at the University of Waterloo, Canada (continued)

The principal obstacle to the success of the Co-op Programme is the high cost of finding and maintaining the placement positions for the student body. The university invests a considerable amount of its own resources in financing and managing the programme. However it now benefits from the high reputation that both the programme and the university's students enjoy, which makes it easier to find firms willing to take the students on work placement. The key lesson to be drawn from this experience is that the investment of resources in a programme such as this can pay dividends to the local economy over a long period of time.

Source: OECD (2010d), *Entrepreneurship, SMEs and Local Development In Andalusia*, Spain, OECD, Paris.

Mobilising social service for long-term community development

In Mexico, the national requirement of mandatory student social service as a graduation requirement has generated good results in mainstreaming community service activities into the core business of the tertiary education institutions and providing experimental learning opportunities for students. For example the Universidad Veracruzana has instituted a minimum of 480 hours of social service in the curricula. Participation of students in the university's service learning/internship programme averages 250 students per semester/year.

The Universidad Veracruzana has made efforts to provide long-term community development programmes, such as *Casas de la Universidad Veracruz* programme (University houses) that help build capacity in the rural and remote areas to help communities to help themselves. For long-term internships, the programme has built dormitories and runs a residents programme. More than 570 students have participated in the *Casas de la Universidad Veracruz* programme delivering a wide range of projects. During their stay in university houses, which are located in remote communities, students provide services in nursing, nutrition, dentistry, lab tests and physical rehabilitation to the local population. Collaboration is based on agreements with the municipalities (president or the head of the family integral development programme), as well as the state and federal government. Authorities support and monitor the activities developed by the students.

Similarly, Monterrey Tech's campus in Veracruz has a community service programme which engages students in programmes that generate

social, economic and education development in marginalised communities and social assistance organisations.

The programmes developed by the Universidad Veracruzana and other tertiary education institutions are notable for their partnerships with external stakeholders and capacity to work across all sectors in sustained commitment. However, there is limited evidence of collaboration between tertiary education institutions in the region and systematic monitoring of results which would help evaluate the outcomes of outreach activities and facilitate scaling up of the good practice examples into a system. The scope and impact of the activities are often constrained by short-term project funding and interventions.

Social service activities have also the potential for internationalisation, building the research base of the university. For example the Tel-Hai Academic College in Kiryat Shmona, Israel which is home to the International Stress Prevention Centre (CSPC, Community Stress Prevention Centre). Originally established as a response to the needs of the local population, the centre has developed an international reputation and expertise in stress prevention. The centre has developed many models for coping with emergency and has published articles and books as well as modular training programmes for psycho-social professionals and multi-disciplinary teams. The CSPC has also trained trainers in stress management (see Box 2.11.).

Box 2.11. International Stress Prevention Centre (CSPC, Community Stress Prevention Centre)

Founded in 1980 in Kiryat Shmonah, the Community Stress Prevention Centre's initial goal was to support the population along Israel's northern border. It is the oldest organisation in the country that deals with the treatment and prevention of psycho trauma. Initially, the centre's aim was giving support to the population of Israel's northern border, including children, adults, education system, municipality and welfare, health and psychological services. This support was in the form of preparatory programmes that helped individuals, communities and organisations cope with the events and emergencies arising from the precarious security situation.

Box. 2.11. International Stress Prevention Centre (CSPC, Community Stress Prevention Centre) (continued)

Today CSPC promotes stress and crisis management on national, organisational, community and individual levels worldwide. It has an internationally acclaimed team of ten experts including psychologists trained in educational and medical psychology and research, social workers specialised in community work, senior school counsellors, and education and emergency management experts. Furthermore, the centre involves professionals from other related fields (organisational consultants, logistics experts, drama therapists) in its projects according to missions to be accomplished. The CSPC has developed many models for coping with emergency and has published articles and books as well as modular training programmes for psycho-social professionals and multi-disciplinary teams. The CSPC has also trained trainers in this field.

The centre is a registered NGO and a not for profit organisation situated in Tel Hai College in Kiryat Shmona. The centre is governed by a professional steering committee. A public inspection committee oversees the aims of the charitable trust section and professional standards. Over the past 30 years, the centre has branched out into stress treatment programmes and consultation for companies and communities wishing to become better equipped to deal with psychological coping in all aspects of life. Thousands of professionals both in Israel and abroad have been trained in the integrative resilience model "BASIC Ph" and in other techniques that develop individual, family, group, system, organisation and community coping skills.

The centre caters to different crisis circumstances – human or natural disasters and to a variety of organisational orientations including business environments where the centre's experts evaluate and consult on business recovery and risk communications management plans. The team was involved in training local professionals in Turkey after the 1999 earthquake, in the USA after 9/11, Beslan, Russia, 2004 following the school massacre and the Far East following the tsunami in December 2004.

Source: International Community Stress Prevention Centre (2010), "The Community Stress Prevention Centre – 25 years of community stress prevention and intervention", www.icspc.org accessed 4 August 2010.

2.4 Building entrepreneurship skills

Entrepreneurship education

A core element of university support for innovation and enterprise in most countries is through new business incubation and graduate entrepreneurship (Potter, 2008). Experience elsewhere shows that the best support for graduate entrepreneurship comes from teaching programmes where students work in teams to form real companies mentored by entrepreneurs. Such programmes can run at undergraduate and graduate levels and be targeted at students from across the sciences, engineering, business and arts disciplines.

In Mexico, entrepreneurship activities in public universities are in an early stage of development. The Ministry of Economy has recently taken steps to enhance entrepreneurship education in public universities and has underpinned this with competitive funding from the Fondo PYME (SME Fund, Small and Medium-sized Enterprise Fund) (see also Chapter 3).

While self-employment is widespread in Veracruz, the tertiary education institutions have embraced entrepreneurship education in varying degrees. The Universidad Veracruzana has a Small Business Incubator and 17 electives at the undergraduate level geared towards entrepreneurship in four different institutes. In Monterrey Tech private university system, all students take part in entrepreneurship education. Courses are delivered using a wide range of learner-centred models, such as problem-based learning, project-oriented learning and research-based learning. The small central Veracruz campus of the Monterrey Tech located in Córdoba offers six bachelor degree programmes and several master and doctoral degrees through the Monterrey Tech's Virtual University.

University entrepreneurship courses and incubation programmes in Veracruz focus on traditional accounting and basic management principles, which are useful but do not necessarily, encourage entrepreneurs. Greater efforts should be made to support entrepreneurship through entrepreneurship education. The state's tertiary education system – the Universidad Veracruzana and the technological institutes – has invested significantly in business incubators, but the current incubation model may require some revision (see Chapter 3 for details).

To sum up, despite incubators, projects, study programmes and initiatives, entrepreneurship education in Veracruz is in an early phase of development, reflected in the limited breadth of entrepreneurship education activities in most tertiary education institutions, the small proportion of

students benefiting from them and the lack of co-ordination between the different departments and institutions. Currently, only limited practical experience in new venture formation is provided for students.

Tertiary education institutions should step up their entrepreneurship activities through a broad portfolio of activities and courses, enhance the institutional anchoring of entrepreneurship education, build capacity among entrepreneurship educators and integrate entrepreneurship education into the curricula. Tertiary education institutions in Veracruz could also share good practices among themselves and the key stakeholders in a more systematic manner. Examples of tertiary education institutions collaborating with each other and key regional stakeholders can be found for example in Brandenburg, Germany where all tertiary education institutions (including universities and universities of applied sciences) have established a joint resource centre in entrepreneurship and small and medium-sized enterprises (SMEs) with the regional development agency in order to boost graduate employment and graduate entrepreneurship and provides services to the regions' SME sector. This initiative helps pool resources, gain critical mass and achieve cost savings (see Box 2.12.).

Box 2.12. BIEM - The Brandenburg Institute for Entrepreneurship and SMEs

The Brandenburg Institute for Entrepreneurship and SMEs (BIEM) is the entrepreneurship institute of the regional development agency and nine public tertiary education institutions including universities and universities of applied sciences. BIEM was founded in 2006 as a registered non-profit organisation. One of its main objectives is to reinforce, complement and co-ordinate the entrepreneurship support activities offered by Brandenburg's tertiary education institutions by pooling resources and enhancing collaboration and exchange. BIEM helps to achieve the "critical mass" needed to realise projects with wide ranging impact.

The annual budget of EUR 100 000 is financed by the European Structural Funds, the Ministry of Economics of Brandenburg and other project-related revenues (e.g. fees for services). BIEM has eight employees. Each partner organisation runs additional projects and employs additional personnel according to project needs or the overall management of an entrepreneurship institute/centre.

Box 2.12. BIEM - The Brandenburg Institute for Entrepreneurship and SMEs (continued)

BIEM's activities include entrepreneurship education, start-up support, entrepreneurship research and networking with business support organisations and other universities. It focuses on the expansion and better integration of entrepreneurship education into curricula, including innovative teaching methods, broad communication of activities, and an expansion of co-operation beyond BIEM's core partners (e.g. by involvement of university staff and external experts, agencies and companies). Partner tertiary education institutions benefit from rising numbers of students participating in entrepreneurship education activities and an increase in the number and variety of courses available for their students.

Tertiary education institutions have established "entrepreneurship location managers/animators" (*Standortmanager*), who act as "one-stop-interlocutors" for would-be entrepreneurs. This structure contributes to building stronger linkages between the university's internal and external support services and to integrating entrepreneurship education and start-up support services. Other projects include "Entrepreneurship ACs", which evaluate entrepreneurial potentials and learning needs before start-up and match them with adequate mentoring during start-up, "Team Competency Lab" that focuses on team building and coaching at the BTU Cottbus or GO: Incubator at the University of Potsdam.

In 2009, 370 would-be entrepreneurs received initial consultation by BIEM, 203 were referred to external business support structures and 86 business start-ups were supported. The key elements for the institute's success are the multidimensional co-operation between all tertiary education institutions and their external partners, the involvement of tertiary education institutions in regional leadership and a phase approach to entrepreneurship.

Source: OECD (2009b), *Universities, innovation and entrepreneurship: Criteria and Examples of Good Practice*, OECD Publishing, Paris; and BIEM-Brandenburg (2010), *Brandenburg Institute for Entrepreneurship and Small and Medium Sized Enterprises*, website, www.biem-brandenburg.de, accessed 10 February 2010.

Finally, entrepreneurship instruction could be undertaken through a series of interactive, reality-based and experiential approaches. These approaches could include virtual or real business creations, business plan competitions, strategy games and discussions with entrepreneurs. These methods would support the development of key entrepreneurial competencies such as creativity, innovation, teamwork, understanding of external environments and networking. Entrepreneurship instruction should not be confined to economics and business departments but made available

across other departments, particularly information and communication technologies, engineering and applied sciences. Rather than offering pure entrepreneurship degrees, entrepreneurship instruction should be integrated into the teaching of other subjects. Table A.2.1 in the Annex identifies various approaches to entrepreneurship education that the tertiary education institutions in the State of Veracruz could consider. The table also identifies some of the challenges involved in these approaches that need to be taken into consideration.

Conclusions and recommendations

In recent years progress has been made in Veracruz to widen access to tertiary education. Efforts have been made to remove geographical barriers to education and to engage adult learners and students from low socio-economic backgrounds. This has been achieved through the expansion of technological institutions which are in close proximity to the local populations, through private universities, which focus on specific markets and through the Universidad Veracruzana Intercultural (Intercultural University of Veracruz). A large number of innovative projects are already in operation, including the Vasconcelos programme. However, compared to international and also national standards, Veracruz remains a highly unequal state in terms of access and success in education.

The tertiary education institutions in Veracruz have taken steps to modernise their educational model and to build stronger links with the industry and the labour market. Innovative examples include the entrepreneurship brigades of the Universidad Veracruzana and the mentoring programme of the Anahuac university at Xalapa. Tertiary education institutions are also engaged in a wider range of social service programmes such as Vasconcelos Programme of the University of Veracruz which provide experiential learning opportunities for students. While commendable progress has been made, stronger efforts are necessary to facilitate the transition towards a knowledge-based economy.

The OECD review team recommends the following measures are taken in promoting human capital development in Veracruz:

- The state government, tertiary education institutions, other educational institutions and key stakeholders of the economy and society should collaborate to agree on region-wide goals, policies and priorities for human capital development from primary to tertiary education, including also workforce development activities. Tertiary education institutions and the government should establish a co-ordinating body to address pathways between universities and

technological institutes and different levels of education. Measures should be put in place to accommodate and encourage mobility within and between institutions by formal agreements to help students move from one institution to another. Tertiary education institutions and the state government should expand efforts to increase the enrolment and success of students from low social and economic background. This would require the removal of the remaining geographical barriers to education, developing academic, social and financial support services for students and building close collaboration between the tertiary education and the primary and secondary education institutions.

- Tertiary education institutions should develop a stronger student-centred approach in their teaching activities. This should built on the international best practice and the existing models in Veracruz. These new forms of education should be more interactive and more tailored to the individual needs and capacities of students and involve work-based and problem-based learning methods and programmes to develop employability, entrepreneurial and transferable skills and English language acquisition. The transferable skills should be embedded in degrees programmes across the academic disciplines (not just in business or accountancy degrees). This would boost the productivity base of the region and enhance its internationalisation efforts.
- Tertiary education institutions and the state government should significantly increase tertiary education opportunities for working age adults, building on the existing courses offered by INEA, Monterrey Tech (online programme) and other universities in Veracruz. The lifelong learning measures should include transparent pathways to advanced education, the ability to attend multiple institutions, obtain short-term education and training that can later be applied to degrees, and re-skilling and up-skilling courses and programmes designed around the needs of working adults. This involves the development of a qualifications framework with strong credit recognition schemes, course and programme articulation agreements, clear and enforceable policies related to credit transfer and support for joint and collaborative programmes.
- Tertiary education institutions and the state government should improve the data on student labour market outcomes and labour market needs and trends. Tertiary education institutions should systematically monitor student progress and achievement and labour market outcomes and graduate destinations (out-migration). The

most effective regional graduate labour market systems are based on the collection of comprehensive labour market intelligence and the on-line publication of the data in a single place to improve students' ability to make rational choices about their studies and to help graduates and employers come together and increase the graduate chances of gaining employment. This data can also be use strategically to identify regional priorities and at an institutional level, to develop course provision and the supply of employer-specific skills.

- In addition to widening access and providing services to disadvantaged communities, tertiary education institutions should make use social service obligations to engage in long-term community development seeking ways to empower communities to find their own solutions to economic, social, cultural and environmental challenges. A systematic exchange of information and experience should be put in place between tertiary education institutions in social, cultural and environmental matters facilitated, for example by the state government in order to bring greater efficiency in social service activities. This forum could organise thematic events, with regular information retrieval and exchange facilitated by a dedicated website. As a first step, the tertiary education institutions' current connections, initiatives and projects in social service should be mapped and published in the collaboration platform.

Annex 2.1: Teaching entrepreneurship approaches

Table A.2.1. Types of entrepreneurship teaching approaches

Type of approach	Main activities	Challenges
Classroom lectures	Lectures on themes such as market analysis, venture creation, new product development, project management, financing, strategy development, etc.	Classroom lectures need to be combined with more experiential approaches to learning. Theory needs to be combined with practice. Lectures must be made relevant to real-world entrepreneurship problems.
Business plans	Preparing business plans individually or in teams. Competitions and prizes for the best business plans.	Business plans must be made realistic. Ways are required to test business plans against market conditions and potential shocks. Teaching must also look at turning business plan ideas into real practice.
Case studies	Presentations and discussions of real company/entrepreneur experiences of business creation, growth, adaptation and failure.	Significant resources are required to develop case studies. Case studies must focus on problems potential entrepreneurs will actually face.
Entrepreneurs as guest speakers	Entrepreneurs invited to present their experiences in lectures and discussions, in the classroom or in their enterprise.	HEIs must find ways of attracting entrepreneurs to teaching programmes. They must also support entrepreneurs in their teaching practice, notably in drawing out the learning from their experiences.
Student business start-ups	Students start real or virtual businesses individually or in teams.	Funds will be required to create start-ups and to develop virtual firm technologies. Rules must be established for sharing rewards from successful starts.
Business games	Computer-simulated or other business games.	The requirements for developing or purchasing the technology should not be underestimated. Efforts are needed to integrate games with other teaching. Teachers need training to provide a framework for learning from the games.
Student entrepreneur clubs and networks	Student societies and networks to discuss entrepreneurship issues, create entrepreneurial teams, obtain mutual support and increase confidence.	Nurturing is required to make networks successful. Activities must be found to animate the networks. Networks should be expanded to include experienced entrepreneurs, investors, consultants, etc.
Placements with small firms	Short-term assignments with small firms to assist with business development projects such as market or technology development.	Firms must be found to provide good quality placements. University staff must support the student during the placement.

Table A.2.1. Types of entrepreneurship teaching approaches (continued)

Type of approach	Main activities	Challenges
Feasibility studies	Exploring the feasibility of business ideas with environmental scans, market potential investigations, competitor analysis, etc.	It can be difficult to assess how well feasibility studies have been undertaken compared with real conditions on the ground.
Communication training	Presentation techniques, interpersonal communication.	Communication skills need to be developed under pressured and real-world conditions.
Consulting for SMEs	Student participation in consulting projects for new and small firms with the support of university staff.	It is necessary to find suitable companies and consulting opportunities. Although academics will often be expected to lead, ways must be found of involving students in the projects.
Support for graduate student start-ups following the course	Seed money, mentoring, incubation, consultancy, etc.	Sufficient funds must be generated for the support. Decisions must be made about the right amount and duration of support. Where possible links should be made with existing support providers outside of the HEI.
University-wide entrepreneurship education	Spreading entrepreneurship teaching out to faculties beyond the business school.	The right balance must be found in a trade-off between the benefits of proximity and tailoring to subject specificities through separate courses for each department and the benefits of economies of scale and greater experience through centralised and interdisciplinary courses.
Specialist entrepreneurship degrees	Undergraduate or post-graduate degrees majoring in entrepreneurship.	It can be difficult to obtain academic rigour from purely entrepreneurship degrees. It can also be difficult to attract students to these degrees. Practical entrepreneurship outcomes are not guaranteed.
Distance education programmes	Use of electronic media including web-based programmes, interactive DVDs and electronic discussion groups.	Student learning rhythm must be maintained and student isolation avoided.
External partnerships	Creation of entrepreneurship centres with financial support from business and public agencies. Advisory boards with external experts.	It is necessary to maintain academic rigour and HEI independence whilst adapting to the concerns of other stakeholders.
Courses for entrepreneurship teachers	Courses for prospective teachers of entrepreneurship to understand the entrepreneur's environment and behaviour and to develop their teaching approaches.	Ways are required to develop insights on the world of the entrepreneur for teachers who have no entrepreneurship experience and to develop teaching abilities in existing or former entrepreneurs.

Source: Potter, J. (ed.) (2008), *Entrepreneurship and Tertiary education*, OECD, Paris.

Notes

1. SNI was created in 1984 in order to promote and assess scientific research and technological innovation. Its members are the top ranking researchers in the country, whose scientific production fulfils international standards.

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Chapter 3: The contribution of research to regional innovation

The promotion of regional innovation is an important driver of long-term economic growth and competitiveness. All regions can improve their capacity to adapt and transfer knowledge to regional needs. This chapter examines the effectiveness of current innovation policies and practices in the State of Veracruz and the role of research and knowledge transfer conducted by tertiary education institutions. It examines the current knowledge transfer and exchange mechanisms and highlights good practice from other regions. Finally, the chapter concludes with specific recommendations to improve the regional innovation outcomes in Veracruz.

Veracruz has an emerging innovation sector, with a research council and supportive financial resourcing. There has been a focus on building research capacity in the University of Veracruz and developing technological education, which builds and maintains links with local industry. The impact of innovation policy is, however, constrained by a number of limitations. These include: i) the narrow focus of research on a limited number of fields, missing the commercial potential of a wider research scope; ii) limited industry participation in R&D expenditure; iii); a lack of a systematic collaboration between firms and tertiary education institutions; iv) tertiary education incubation services that benefit only a small number of enterprises and v) fragmented support for small and medium-sized enterprises. As a result, the full capacity of universities and other tertiary education institutions has not been mobilised for innovation and new business generation.

The key message is that the state government and tertiary education institutions need to rethink their approach to business generation and development. Stronger collaboration between tertiary education institutions and industry is necessary. Efforts are also needed to ensure that the public support for incubators does not undermine its own goals in developing new entrepreneurship. Finally, innovation should be understood in broad terms in order to address the regions key social challenges and to mobilise wider university community for change.

Introduction

The Veracruz economy has gradually improved over the recent years. According to the states' competitiveness index of the Mexican Institute for Competitiveness, Veracruz ranked 26nd among 32 Mexican states in 2008 (against 28 in 2003) (IMCO, 2008). Progress has been achieved with regard to economic dynamism, political stability and the use of non-renewable resources. However, Veracruz is also confronted with challenges including: *i*) inadequate access to communications and public services in rural areas, *ii*) low productivity of the labour force, *iii*) low diversification of industries in the northern and southern parts of the state and *iv*) lack of a co-ordinated strategy among government agencies.

The Veracruz economy is dominated by traditional sectors and combines characteristics of peripheral and old industrial regions. These types of regions are often less innovative in comparison to more central and agglomerated regions. They have a lack of dynamic clusters and low levels of R&D and innovation. Their economy is dominated by small and medium-sized enterprises in traditional sectors and/or branch plants with limited absorptive capacity (peripheral regions) or mature industries and externally controlled firms (old industrial regions). Various forms of "lock-in", such as excessively strong business and policy networks and narrow orientation of knowledge providers, may also hamper regional development. The focus in these regions is on incremental and process innovations [(Tödting and Tripl, 2005); see Box A.3.1. in the Annex)].

The State Government of Veracruz, through its development plan for 2005-10, has aimed to improve the economic growth by promoting competitiveness and productivity and by attracting inward investments. In the context of limited diversification of industry base, low productivity and low skilled population, this chapter will examine the following three dimensions to assess the effectiveness and coherence of innovation and R&D policies and practices in Veracruz and the role that the tertiary education institutions play in the regional innovation system:

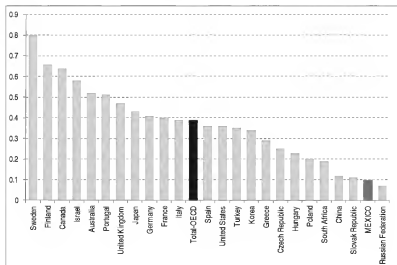
- Is the innovation system well connected and responsive to the industrial structure of Veracruz?
- Do the tertiary education institutions support the regional innovation system in an optimal way? Are there gaps in delivery where performance could be improved?
- What lessons can be learnt from international experience?

3.1 National policy framework

Funding

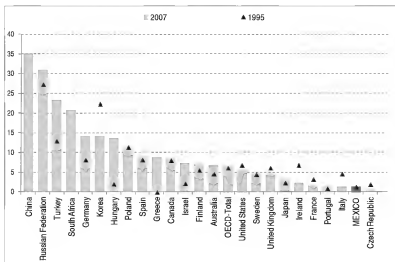
Mexico is among the lowest investors in the OECD area in terms of the expenditure on higher education R&D (HERD) as a percentage of GDP as well as the share of funding from industry to tertiary education R&D. Mexico's expenditure on higher education R&D as a percentage of its GDP was 0.1% in 2008 as compared to OECD average of 0.39%, while business and industry funded 1.3% of the Mexican tertiary education R&D in 2007, as compared to the OECD average of 6.5% (see Figures 3.1. and 3.2.).

Figure 3.1. HERD as a percentage of GDP in selected countries, 2008¹



1. Or nearest available year.

Source: OECD (2009a), Main Science and Technology Indicators, OECD, Paris.

Figure 3.2. Percentage of HERD financed by industry in selected countries, 1995 and 2007¹

1. Or nearest available year.

Source: OECD (2009a), Main Science and Technology Indicators, OECD, Paris.

With only 0.44% of GDP invested in R&D, Mexico compares poorly with the OECD average (2.5%), and other Latin American countries such as Brazil (0.98%) and Chile (0.6%). The contribution of Mexican tertiary education institutions to R&D is also relatively low in international comparison, standing at 0.12% of national GDP. Nevertheless, given the low level of industry and government involvement, the share of tertiary education institutions in R&D investments (38%) is above the OECD average. The quality of university research is affected by the low proportion of faculty with PhD degrees (less than 10% at the national level).

Pro-innovation policies

While progress has been made in developing a national innovation system in Mexico, the national policies do not yet sufficiently support regional innovation systems or clusters. There is no co-ordinated regional development policy approach and current efforts for regional development focus on poverty or infrastructure rather than competitiveness. Some enterprise-related policies (sectoral, small and medium-sized enterprises,

FDI programmes) consider regional specificities while most sectoral programmes are place-blind (OECD, 2009b).

While the Mexican Science, Technology and Innovation (STI) Policy is increasingly recognising the importance of regional innovation systems, the concentration of innovation resources in Mexico City, and to a lesser extent in Monterrey, slows down the capacity building at the state and sub-national levels. The overall national budget for STI programmes is also relatively small and the regional allocation is a small, albeit increasing share of the budget (OECD, 2009b).

The National Science and Technology Council (CONACyT) provides incentives for regional engagement of tertiary education institutions to foster knowledge transfer and university-industry collaboration. CONACyT uses the Mixed Funds Programme (*Fondos Mixtos*, FOMIX) and Alliances and Innovation Networks for Competitiveness (AERIs) to promote scientific and technological development at the sub-national level. Both require participation of a tertiary education institution. In 2009, the Institutional Fund for Regional Development through the promotion of Science, Technology and Innovation, FORDECYT, was created to complement the FOMIX programme by targeting both geographic regions (states of neighbouring municipalities) and thematic regions (groups of municipalities or states with common challenges). CONACyT also has a programme with the Mexican Institute for Intellectual Property (IMPI) to support technology transfer offices in tertiary education institutions, research centres and other institutions. Furthermore, CONACyT supports the emerging regional innovation systems through financing advanced degree training, competitive research and scholarship. There are 27 CONACyT centres around the country (OECD, 2009b), including the Institute of Ecology (INECOL) in the City of Xalapa in Veracruz.

3.2 Veracruz governance mechanisms and funding

In Veracruz, the innovation sector is under the supervision of the Veracruz' Council for Scientific Research and Technological Development (COVEICYDET), which in 2005 produced the State Science and Technology Plan (2005-10). This plan outlines what is required for the development of an integrated innovation policy in the state. It is, however, not clear whether the right organisation and resources have been put in place for the implementation of the plan. While important elements of the plan are moving forward and are adequately resourced, the overall resources dedicated to the plan remain limited. Furthermore, the institutional capacity to plan and implement innovation policy is in need of strengthening.

The state agency that provides key subsidies to science, technology and innovation, the Veracruz' Council of Science and Technology (COVECyT), is a new agency: it began its operations in 2006, and was the last state innovation agency to be established in Mexico. The main activity of COVECyT is the operation of FOMIX (*Fondos Mixtos*, Mixed Funds), a fund that works through calls for proposals and awards subsidies to research institutions on a competitive basis. A total of 123 projects have received support, their awards totalling about USD 10 million. Most projects belong to the category of applied research and over half of them are concentrated in the fields of biotechnology, biology, chemistry, earth sciences, physics and engineering. Although the contribution of FOMIX is important in developing standard and key innovation policy instruments upon which larger and more complex policies can be built, it remains very small and the concentration on applied research means the whole area of business innovation is not the focus of the mainstream policies of COVECyT. The new innovation activities of the COVECyT linked with the promotion of CONACyT federal government programmes such as INNOVATEC, INNOVAPyme and INNOVA have generated more than 50 projects of innovation in various industrial sectors. The COVECyT is also increasingly engaged in recycling of waste materials and the production of energy through the recycling processes.

The FOMIX is funded by a combination of federal (CONACyT) and state funds, each providing approximately 50%. Research institutions in Veracruz can also apply for federal grants, mostly applicable to basic research or applied research in specific sectors such as agriculture, forestry and environmental protection. Between 2002 and 2007 these resources totalled approximately USD 1 million. In addition, USD 2 million is allocated in federal grants to COVECyT and other governmental agencies for the promotion of research innovation in industry.

The question of concentration versus dispersion of innovation-related resources is a challenge in many OECD countries. While innovation resources are typically more concentrated than the general population, the balance between a pure excellence-based allocation mechanism and remediating measures for lesser developed regions remains an open debate (OECD 2009b). In Mexico, FOMIX is the most direct instrument aimed at promoting scientific and technological development at sub-national level. However, Veracruz and other less developed states have to implement specific programmes to overcome their innovation deficits. Mexico and the State of Veracruz could consider the US examples of programmes designed to address the challenge of research and education concentration across the country (see Box 3.1.).

Box 3.1. Supporting R&D capacity in less advanced US states

The Experimental Program to Stimulate Competitive Research (EPSCoR) assists the National Science Foundation (NSF) in strengthening “research and education in science and engineering throughout the United States” and avoids undue concentration of such research and education. EPSCoR is directed at areas that have historically received lesser amounts of NSF R&D funding. EPSCoR’s goals are: i) to provide strategic programmes and opportunities that stimulate sustainable improvements in R&D capacity and competitiveness; and ii) to advance science and engineering capabilities for discovery, innovation and knowledge-based prosperity. 25 states, the Commonwealth of Puerto Rico and the US Virgin Islands currently participate in EPSCoR.

Through EPSCoR, NSF forges partnerships with government, tertiary education and industry to bring long-term improvements in a state or region’s research infrastructure and R&D capacity and competitiveness. Planning support is also available to formulate a documented vision and implementation design for research, education and innovation strategies. EPSCoR has three key support mechanisms:

- Research Infrastructure Improvement grants run for 36 months and provide up to USD 9 million to support infrastructure improvements in science and technology (S&T) areas chosen by the applying jurisdiction’s EPSCoR governing committee as critical to future R&D competitiveness.
- Co-funding mechanism enables more awards to be made to researchers in eligible areas from the NSF’s ongoing research, education and special emphasis competitions, by providing partial support for those proposals that merit review places at or near the cut-off for funding by the reviewing programme.
- EPSCoR Outreach provides financial support for outreach visits by NSF staff to acquaint researchers with NSF priorities, programmes and policies.

Box 3.1. Supporting R&D capacity in less advanced US states (continued)

The Institutional Development Award (IDeA) programme broadens the geographic distribution of National Institute of Health (NIH) funding for biomedical and behavioural research. IDeA fosters health-related research and enhances the competitiveness of investigators at institutions located in states in which the aggregate success rate for applications to NIH has been low. IDeA increases the competitiveness of investigators by supporting faculty development and research infrastructure enhancement at institutions in 23 states and Puerto Rico and has two main components:

- Centres of Biomedical Research Excellence (COBRE) strengthen institutional biomedical research capabilities by developing biomedical faculty research capability through support of a multidisciplinary centre, led by a NIH-funded investigator.
- IDeA Networks of Biomedical Research Excellence (INBRE) enhance biomedical research capacity, strengthen the research capabilities of biomedical faculty and provide access to biomedical resources for promising undergraduate students. INBRE implements the IDeA approach at the state level by enhancing research infrastructure through support of a network of institutions with a multidisciplinary, thematic scientific focus.

Source: OECD (2009b), Reviews of Regional Innovation, 15 Mexican States, OECD, Paris.

In the end of 2009 the State Government of Veracruz, through COVECyT, announced a new Innovation Fund, backed up with almost USD 14 million. The aim of this fund is to encourage firms in Veracruz to undertake innovation projects focused on technology.

More significant is, however, the funding involved in tax breaks that apply to firms that declare innovation activities; between 2001 and 2007 the exemptions going to these firms totalled approximately USD 22 million. Fiscal stimuli are widely used innovation policies around the world, with a few highly-developed economies using them as primary instruments and others avoiding them altogether. Most evidence related to developing countries points to their relative inefficiency, given the difficulties in defining what counts as investments in innovation. The list of recipients of the tax breaks in the case of Veracruz suggests that fiscal exemption is not

an appropriate tool to encourage innovation in small and medium-sized firms. Authorities are aware of the shortcomings of the fiscal stimuli and have increased FOMIX funding. In Veracruz, they have also launched the Innovation Fund to replace fiscal stimulus, which will be phased out.

Provided that FOMIX and the new Innovation Fund will continue to operate, the State of Veracruz will have two powerful policy instruments at the service of innovation, with which it could build additional tools to better target at specific constituencies, such as different types of businesses, or develop sector-based strategic policies, aimed at agribusiness, environmental or energy sectors.

3.3 Regional innovation system

In 2008, the National Council of Educational Authorities (*Consejo Nacional de Autoridades Educativas*, CONAEDU) established a new strategy to promote co-operation between tertiary education institutions and the productive sector. This strategy established three levels of co-operation at local, state and national levels and included the creation of foundations that bring together HEIs, private sector and government. Limited evidence was available to evaluate the outcomes of this collaboration.

In the case of Veracruz, as well as the majority of the Mexican states, inputs for innovation can only be measured indirectly, since there are no available data on public or private R&D expenditures (OECD, 2009b). An indirect indicator of public expenditures is the amount of resources provided by CONACyT per state and the resources provided by other ministries for S&T activities. In 2001-07, CONACyT provided almost USD 1 697 million to the 32 states; Veracruz received 2.01% (USD 34.4 million) of this funding. The allocation is divided between: FOMIX Mixed Funds (9%), basic science (10%), sectoral funds (14%), fiscal stimulus (65%) and other programmes (1.5%). The amount of resources allocated to Veracruz from the Fiscal Stimulus programme and FOMIX in the last six years ranks the state 12th and 11th nationally. This positioning is consistent with RENIECyT (National Registry of Scientific and Technological Institutions and Firms) which also ranks Veracruz in the 12th place. At the same time, however, human capital inputs reveal an imbalance between Veracruz's ranking in its SNI researchers (10th place), its postgraduate programmes in CONACyT (10th place) and its enrolment rate in tertiary education (22nd place). The same asymmetry appears between the number of researchers and the output of patents and scientific publications (27th place). With respect to the performance of the private sector, Veracruz lags behind in high-tech output (17th place)¹ and investment in R&D (27th place).

The impact that the policies on tertiary education, R&D, S&T and innovation have on competitiveness and the advancement of a knowledge-based society in Veracruz is not yet recognisable. The strengths of Veracruz in terms of competitiveness are its 2nd-place ranking in port freight, 2nd-place ranking in crime reduction, its 3rd-place ranking in successful labour conflict solutions and its 4th-place ranking in investments made by the public sector. Veracruz's competitiveness lacks in the following areas: international relations (31st place), environmental management protection (29th place), a system of justice (28th place) and health services (28th place).

The research system in Veracruz is mainly composed of public research institutes (see Box 3.2.) and a few large firms. The most important component is the University of Veracruz, which encompasses 32 schools and 22 institutes and research centres, including the Advanced Technology Lab in Xalapa (LATEX) and the College of Graduate Studies in Agricultural Sciences (COLPOS). There are also several technological institutes and a small number of federal research centres, for example the Institute of Ecology (INECOL)² and the National Institute of Forestry, Agriculture and Livestock Research (INIFAP).³

This fragmented research system is supported by the agreements that the Universidad Veracruzana has signed with other universities such as the Polytechnic, the technical universities (*universidades tecnológicas*) and smaller institutions, such as the Cristobal Colón University or Jean Piaget University. Intermediary organisations are also affiliated with the tertiary education institutions that provide research services. For example, LATEX (240 researchers) offers information services, applied research, chemical analysis, technical assistance and quality control to customers.

Veracruz has a number of research institutes that provide a basis for knowledge-intensive economy and innovation (see Box 3.2.). These institutes concentrate the highly skilled human capital in Veracruz, acquire sophisticated scientific equipment and establish a presence beyond the state borders. Many of them were conceived from the start in close contact with business activities/needs and are able to provide consulting and applied research inputs to firms. However, these institutes are at different stages of development and have varying degrees of research capacity. Other important sources of research include independent institutes unaffiliated with universities, the federal government and large firms.

Box 3.2. Research institutes and links to the Universidad Veracruzana

LATEX (Advanced Technology Lab in Xalapa): This laboratory started activities in the late 1990s as partnership between the University of Veracruz and the Veracruz chamber of industries (AIEVAC). In a decade, it has completed approximately 2 000 projects involving technological services, such as chemical analyses of agricultural products, water and soils; quality control, inspection and standard verification in food production; specialised training for businesses; and a variety of laboratory tests demanded by the agricultural and industrial sectors. It has worked closely with the university in facilitating thesis work and internships for students.

LANIA (National Lab for Advanced Computing): Founded in the early 1990s as an initiative of the Government of Veracruz, this laboratory aims to build local capacities in the emerging areas of ICT. It has evolved into an independent institution that is still related to the state government, but operates based on a business model that promotes servicing private industry with ICT services and applied research. LANIA researchers have a solid track record of peer-reviewed publications, considerable activities in licensing and patenting, and a portfolio of clients, including businesses and governmental agencies from other Mexican states and abroad. It has developed solid international research alliances, e.g. with France. Mixing high performance in services and applied research and a business-oriented culture, it constitutes a source of strength for the state in the critical ICT field.

Universidad Veracruzana's Research Centre on Micro and Nano-Technology (Microna) – Tenaris-TAMSA R&D Laboratory: Building on a smaller-scale initiative supported by the state government, the university established this centre in 2005 to undertake basic research, technological services and industry in the areas of microensors, advanced materials and nanotechnology. A decisive contribution to the launching of the laboratory was the partnership that the university developed with Tenaris-TAMSA, a worldwide steel and tube manufacturing corporation that has had a long-term presence in Veracruz as a major supplier to PEMEX (the state-owned oil company). Tenaris-TAMSA decided, within the framework of building a major new industrial plant, to locate a major R&D and quality control facility in Veracruz – a research centre that formed a partnership with the university in order to achieve an optimal mix of basic and applied research. The initial collaboration on research projects led to a larger agreement that included the development of degrees in metallurgical engineering, graduate programmes at the university, the endowment of laboratories and the circulation of researchers between Tenaris-TAMSA laboratory and the university. Not counting proprietary intellectual outputs belonging exclusively to Tenaris-TAMSA, Microna has produced the first batch of patents in the university's history.

In some cases, tertiary education institutions' research departments are supported and partially funded by large firms. However, there are not many examples of this type of collaboration in Veracruz. Among the large companies collaborating with the Universidad Veracruzana is PEMEX, the Mexican state-owned oil company. Through a three-year agreement it supports the university with MXN 120 million which is then channelled into different projects dealing with skills assessment, professional training, technical assistance, workplace safety and environmental certification. Most of PEMEX projects are collaborations within the department of environmental science and refer to the environmental and social sustainability of oil extraction and production.

Tenaris-TAMSA, a large private company with 17 000 employees internationally and produces steel pipes for oil companies operating offshore, is one of them. It co-operates on new materials with the Universidad Veracruzana's School of Engineering and is helping to turn the college into a faculty. The company has also contributed to the creation, in 2005, of the Centre for Micro and Nanotechnologies (Centre for Design), which is made up of a multidisciplinary team and is certified SNI (National Researchers' System) and PROMEP (Faculty Improvement Programme). It has recently received resources (about USD 5.1 million) from the National Council of Science and Technology (CONACyT) and also from the Mexican Oil Company PEMEX. On average, however, firms devote modest spending to contract research. This could be attributed to the weak collaboration culture in Veracruz and the difficulties that the universities and other tertiary education institutions face in communicating their services and research results.

The relatively narrow spectrum of research fields covered – mainly agri-food, basic metals, health, petrochemicals and energy – and low investment in R&D (not exceeding 0.1% of the state GDP) also explains the weak innovation performance of Veracruz. In addition, technological disciplines attract a relatively low number of researchers. Among the 267 nationally designated quality researchers (SNI Researchers)⁴ employed in Veracruz, more than a third work in humanities and social sciences. Furthermore, the share of manufacturing firms that invest in the creation of new products, materials or components is below national average (around 28%, compared to the national average of 34%).

The Veracruz research system also possesses some strong assets. The healthcare laboratory has a well-established reputation in Mexico (security level 3, an infrastructure of 1 000 m²) and benefits from the support of CONACyT. It carries out epidemiological diagnostics (tuberculosis,

dengue), research (AIDS, tuberculosis) and scientific training. At the same time, new clusters are emerging, particularly in the fields of ICTs (around LANIA) and in the food and beverage industries. Agriculture in Veracruz is highly diversified (coffee, cocoa, vanilla, horticulture, marine products) due to its biodiversity: 7.6% of Mexican agricultural production comes from Veracruz.⁵ With funding from the State of Veracruz, CONACyT and the Organisation of American States (OAS, OEA in its Spanish Acronym) COVECyT has established a technological and scientific centre in Xalapa the *Centro Latinoamericano de Biotecnología Agropecuaria* (CELABIA), that focuses on research and innovation in agrifood.

Tertiary education institutions are important “bricks” in the emerging regional innovation system (RIS) in Veracruz. Veracruz possesses all the main components of a well-functioning RIS. In recent years strong progress has been made in developing and maturing the regional innovation system (see also Box 3.3 for RIS in Latin America). However, more efforts are required in institutional development and linking different elements together. There is a need to improve collaboration between tertiary education institutions and businesses (*i.e.* using the “mortar” to fully articulate the RIS).

Box 3.3. Regional Innovation systems: Linking education, innovation and government in Latin America

Given the combined pressures of state reform, democratisation and an increasingly competitive international economy, regions and cities are rapidly becoming cornerstones of economic and social development. Changing patterns of trade and technological possibilities in the world economy create strong pressures on sub-national entities to develop and sustain competitive advantages. The centrality of knowledge-based industries and services becomes unavoidable and makes people, skills (knowledge capital) and entrepreneurial capacity a necessary condition of maintaining and lifting living standards, as well as of creating sustainable local economies.

Enhancing local competitiveness has rapidly become a widespread and highly-valued policy goal in regions and cities around the world. Well-developed innovation systems have emerged as the backbones of competitiveness not only for nations as a whole, but for local and regional jurisdictions. Innovation thrives in cities and regions in which agglomeration economies can be maximised through industry clusters and partnerships between both public and private companies and firms and universities.

Box 3.3. Regional Innovation Systems: Linking education, innovation and government in Latin America (continued)

This requires: *i*) human capital development (high performance education systems); *ii*) innovative firms and their environment (including regulatory institutions, scientific and connectivity infrastructure) and *iii*) high quality of the regional and local political process that allows for good governance, long-term planning and consensus building around the notion of competitiveness.

In Latin America, as far as human capital development is concerned, some state, province and city school systems have made improvements in equity, quality and overall organisation and performance that are counted as among the most successful of the last two decades. Such educational progress is being framed in the larger context of regional innovation systems and the ability of particular localities to become competitive at the international level.

As far as creating incentives for innovation at the firm level, public policies in larger countries, such as Brazil and Mexico, had by the 1990s developed specific funds aimed at encouraging industrial development and even technology-based innovation to be allocated on a territorial basis. This has played an important role in preparing the field for the recognition of regional innovation systems, which manifests itself e.g. in the development of the Mexican state of Nuevo Leon as Monterrey City of Knowledge. The private sector itself, through its own organisations, has also become an important player in driving innovation forward and demanding sound education and innovation policies from the regional and municipal governments.

Despite the progress made in education and business innovation, challenges remain. These include: education quality, which falls short of the standards of advanced economies and competitors in Asia. On the business side, the proportion of firms that have embraced technology-based innovation as a source of competitive advantage is small evidenced by the low level of private investment in R&D in Latin America. Stronger efforts are needed before effective regional innovation systems are within the reach for most areas.

Source: De la Cruz, R., C. Pineda and C. Poschl (eds.) (*forthcoming*), “Descentralización y Desarrollo Local en América Latina” (Decentralisation and Local Development in Latin America), Inter-American Development Bank, Washington.

Regional competitiveness framework of Veracruz

A regional competitiveness framework is often seen as the key to regional development. The regional competitiveness approach argues that regional capacity can be nurtured and developed by identifying their competitive advantages. Furthermore, public investments must be aligned

with economic niches (Porter, 1998 and 1999). Table 3.1 shows the progress made in Veracruz in terms of the four essential elements for competitiveness in the global economy: strategy, governance, innovation and entrepreneurship. It also identifies a number of gaps that need to be bridged.

Table 3.1. The Veracruz competitiveness framework and tertiary education institutions' role

Essential ingredient	Target (Ideal)	Veracruz (Actual)
Strategy	To identify the region's distinct competitive advantage. To align public and private actions necessary to seize it.	Plans to attract business and inward investment. Actions and success in expanding technological education, but less clarity in science and technology activities by tertiary education institutions.
Governance	To supply a framework to unite public, private and non-profit leaders as a collective guide and owner of the strategy.	State Government's Science and Technology Plan that outlines the steps required for an integrated innovation policy. Foundations, that bring together tertiary education institution, business and government, created on the basis of the strategy by National Council of Education.
Innovation	To link the region with new technologies and new ways of working and living that can transform the region's social and economic assets.	RDI activities of tertiary education institutions focus on a few fields with limited alignment to the economic assets and needs of the state for industry diversification. Knowledge transfer and innovation through social service and education.
Entrepreneurship	To provide a fertile climate in which new ideas can be transferred successfully into the marketplace.	Entrepreneurship initiatives are at incipient stages in HEIs. Incubators are in place but they do not focus strongly enough on knowledge-based start-ups.

Source: Adapted from Drabenstott, M. (2008), "Universities, Innovation and Regional Development: A View from the United States", Tertiary education Management and Policy, Vol. 20, No. 2, OECD, Paris, pp 43-55.

3.4 Linkages between tertiary education and industry

According to the goals of the National Education Programme 2007-12, the Ministry of Public Education fosters the participation of the tertiary education institutions in economic, social and human development programmes. Mexico features examples of interaction between institutions

and industry, of which collaborative research and informal contacts are the most common. Collaborative research, as it normally involves funding, is easier to trace. In 2007, the proportion of tertiary education expenditure on R&D (HERD) financed by industry amounted to 1.3% (OECD, 2009a) – one of the lowest levels in OECD countries.

Table 3.2. Overview of the collaboration of the Universidad Veracruzana with the productive sector

	Xalapa	Veracruz	Orizaba	Poza Rica	Coatzacoalcos	Total
Projects	197	94	47	97	40	475
Academic units	36 (75)	13 (23)	8 (12)	12 (18)	7 (12)	76 (140)
Faculty	433	172	90	130	71	896
Students	607	533	517	483	237	2377

Source: Universidad Veracruzana (2010), “Sistema de Información para la Vinculación Universitaria” (*Information system for the university*), www.uv.mx/sivu, accessed 10 December 2009.

Table 3.2 provides an overview of the overall engagement in terms of projects, academic units, faculty and students in activities with the private sector. Data refers only to the Universidad Veracruzana, which is the state public university and has five campuses in different cities. Poza Rica has the highest percentage of academic units working with the productive sector (12/18 - 66%), while the campus in Xalapa has the lowest percentage (36 - 75). This might reflect the nature of the two cities, as Poza Rica is primarily an industrial city and Xalapa is the administrative capital of the state where entrepreneurialism and business dynamics are more stagnant.

Table 3.3. Number of projects of the Universidad Veracruzana with the productive sector by campus and area

Academic Area	Xalapa	Veracruz	Orizaba	Poza Rica	Coatzacoalcos	Total	Area %
Technical	26	22	9	18	3	78	16
Humanities	14	7	1	7	3	32	7
Administration	36	18	9	20	4	83	17
Health science	19	9	2	9	2	41	9
Biology/agro-fish	94	34	30	42	28	228	48
Other	8	4	0	1	0	13	3
Total	107	94	47	97	40	475	100
% by campus	41%	20%	10%	20%	8%	100%	

Source: Universidad Veracruzana (2010), “Sistema de Información para la Vinculación Universitaria” (*Information system for the university*), www.uv.mx/sivu, accessed 10 December 2009.

Almost half of the collaborative projects with the private sector fall under the academic area of biology and agro-fishing, which reflects the agricultural and farming vocations that remain predominant in large parts of the state. The two smallest campuses, Orizaba and Coatzacoalcos, are the campuses that contribute the least to partnerships with the private sector. In addition, Veracruz's campus probably contributes less to these partnerships, especially when compared to the smaller campus of Poza Rica, where the lion's share of projects is in the field of biology.

In terms of projects by sector (not in the table), almost half (45.8%) are in agriculture and fishing, followed by services (27.6%), manufacturing (17.8%) and retail/wholesale trade (8.7%). The Universidad Veracruzana should make urgent efforts to build stronger links with the manufacturing sector to encourage the introduction of product and process innovations in local firms. Contrary to many other regions, the collaboration of the University of Veracruz with the private sector does not appear to be depend on the firm size: of the 366 firms formally collaborating with the university, 82 are micro, 87 small, 131 medium and 66 are large companies.

In recent years, the State of Veracruz has seen the emergence of a strong technological education sector (see Chapter 2). The technological institutes' model appears successful. Technological institutes reach out to students in peripheral areas and marginalised communities, who seem satisfied with the labour market opportunities that their degrees offer (OECD, 2008). Their links to the productive sector are fairly strong, even if the original idea (that as much as 25% of the technological institutes' costs should be covered by the private sector) has evaporated over time. They have also undertaken the important task of capacity building in the firms. Finally, the technological institutes' system has shown the capacity to attract SNI researchers,⁶ receive CONACyT funding,⁷ and sign international agreements regarding research and student-mobility collaboration with universities in the United States, Europe and the rest of Latin America.

Universities, however, face greater challenges in industry collaboration. Despite promising progress and initiatives, such as the enterprise brigades of the Universidad Veracruzana and the mentoring programme at Anahuac University at Xalapa (UAX) (see Chapter 2, Box 2.8.) industry-university relationships remain limited. There is mutual distrust and firms and universities are considered to have different aims, timelines and problems. Furthermore, many small firms are necessity-driven and not interested in collaborating with tertiary education. In the case of growth-oriented firms there may be too large a divide between applied research and basic university research. The low level of co-operation is highlighted by the lack of collaboration with the local chamber of commerce.

Industry-university relationships work, when there is an interest and an ability from small firms to co-operate with academic institutions. Policy measures that boost skills development, labour mobility and innovation purchasing can stimulate this demand. Local firms, which tend to be small, need be exposed to the importance of innovation and collaboration with universities through initial awareness campaigns. Currently, firm innovation in Veracruz takes place mainly through relationships with business partners (clients and suppliers) and imitation of competitors. While this strategy is well suited for incremental improvements, it is less fit for radical breakthroughs in the production process.

The lack of internationalisation dimension is an acknowledged weakness in the regional innovation system. Tertiary education institutions in Veracruz should more actively participate in international projects in the field of technologies with European and Asian countries which have a strong tradition in technological education. The state government could facilitate this development by establishing a state level co-ordination office.

Cluster development

Internationally many tertiary education institutions and their regional partners are focusing on cluster development as a way of maximising impact of their industry engagement and tapping into existing industry networks. Clusters, *i.e.* agglomerations of firms, supporting institutions and infrastructures in inter-related industry areas, may have been initiated also by the government. However, often the most successful clusters evolve independently of government support. Government cluster policies may be targeted on existing operating clusters or may be directed towards the development of new clusters from some pre-existing core activity (Hertog *et al.*, 2001).

Cluster development is at early stages in Veracruz. COVECyT has taken steps to launch a cluster programme with focus on agriculture and biotechnology (CELABIA research centre), petrochemical industry, and biomedicine, the biomedical research centre for infectious diseases (CIBEI). The university-industry collaboration in Veracruz has been concentrated in areas such as biology, agro-industry and electronic engineering, which is due to greater demand for university services in these domains and a more proactive attitude of these departments towards co-operation with industry.

In Veracruz, the state government and the Universidad Veracruzana should collaborate in diagnosis to identify the driving sectors of the regional economy. Based on this diagnosis, funding for R&D and co-operation between the university and industry could be channelled accordingly. The government should ensure that research on clusters and demands of industry

extend also into service sector and include clusters such as tourism. Clusters should be conceptualised as cutting across the manufacturing-service divide – for example agribusiness clusters usually connect with tourism and manufacturing innovations incorporate service components. This would lead to an extension of the technology platform of the Universidad Veracruzana as well as diversification of its relationship with industry.

Another strategic action should be to attract a larger number of business partners from different sectors into collaborative projects with the Universidad Veracruzana and other tertiary education institutions. So far, the focus has been on agriculture and fishing, but not so much on the chemical and plastic sectors despite the importance of the local oil industry. Similarly, improved industry-university relationships should be used to launch new sectors by harnessing the excellence available within the state university system. For instance, biotechnologies have been only used in the agro-industry, whereas they could also be applied to the pharmaceutical sector. The cross-fertilising potential of cutting-edge technologies should be better recognised and exploited to foster new value-added sectors. Non-high-tech industries and services should also be a target, but would require the university to better exploit its research potential in areas such as tourism, logistics, construction, waste management, water quality and solar energy (*i.e.* areas congruent with Veracruz's real or anticipated comparative advantages).

Enhancing collaboration

A central concern of this review is establishing the extent to which tertiary education institutions respond to the needs of their surrounding regions at Veracruz and what mechanisms are in place to facilitate this. Table A.3.2. in Annex identifies a range of mechanisms that facilitate knowledge exchange between tertiary education and business and industry. Such mechanisms include: licensing, spin-offs, technology transfer offices, technology brokers, science parks and incubators. In this context, there is room for improvement in Veracruz.

There are currently limited incentives for regional engagement of tertiary education institutions and their staff. Collaboration of tertiary education institutions with the private sector has so far been left to the will and initiative of single departments and individuals. A clearer strategy at both the state and institutional levels would enhance the impacts of such relationships on innovation and economic growth. This strategy should build on the existing strengths of the state and develop related sectors and technologies. Economic analysis shows that diversity among complementary economic activities with a common science base is more conducive to

innovation than a narrow sector specialisation. Technologies with cross-sector fertilisation potential should be promoted. Table 3.4. gives a snapshot of how new technologies are being applied to different sectors.

Table 3.4. The match between new technologies and sectors

Sectors	New technologies									
	Biotech	Laser	Know. System	Micro system	New mat.	Chem.	Med eng.	Energy/e nviron	Traffic eng.	ICT
Automotive										
Electric										
Mech. eng.										
Nutrition										
Pharma										
Building										
Plastics										
Ceramic										
Textiles										
Metal proc.										

Source: Bayern Innovative Technology Platform, www.bayern-innovativ.de accessed 1 September 2010.

Innovation often emerges through the exchange of ideas among actors that are connected with each other as opposed to individuals that work in isolation. The prevailing innovation system approach has shown that the independent generation and application of knowledge by science and industry does not yield positive outcomes. Various types of networks support collective learning, but given the externalities involved, public initiatives are often required to support the development of networks that bring together tertiary education institutions and firms. In doing so, the tacit nature of knowledge transfers should be recognised and frequent and informal interpersonal interactions encouraged through, for example, shared spaces and facilities. It would be important to reinforce the regional engagement channels of the tertiary education institutions through the development of their forum role with local and regional small and medium-sized enterprises and clusters (see Box 3.4.).

Box 3.4. Developing public space in universities

In most cases, the indirect support provided by universities for local innovation processes is likely to be more important than their direct contributions to local industry problem solving. In addition to educating and raising the skills levels of the local population, a university can also play an important role by providing a public space for on-going conversations that involve local industry about the future direction of technologies, markets and local industrial development.

This public space role can take many forms, including meetings, conferences, industrial liaison programmes, standards forums, entrepreneur/investor forums, visiting committee discussions of departmental curricula. The conversations between university and industry people that occur in these spaces seldom focus on solving specific technical or commercial problems, but often generate ideas that can become the focus of problem-solving both in industry and in universities. The importance of the public space role of the university and its contribution to local innovation performance is frequently underestimated and underdeveloped by tertiary education institutions.

Source: Lester, R. K. (2005), Universities, Innovation and the Competitiveness of local economies, A summary report from the Local Innovation System (LIS) Project : Phase 1, Industrial performance Center, MIT, Cambridge.

Veracruz economy is dominated by small and medium-sized enterprises. Creating demand in private sector for HE R&D and innovation requires stronger policy incentives. The Dutch Knowledge Vouchers to SMEs (see Box 3.5.) deserve attention due to their strong emphasis on knowledge transfer from tertiary education institutions.

Box 3.5. Knowledge Voucher Programme in the Netherlands

The aim of the Knowledge Voucher Programme is to encourage knowledge transfer knowledge institutes, such as universities and universities of applied sciences, to small and medium-sized enterprises (SMEs) and to help SMEs to access and use the knowledge produced by knowledge institutes for the development of new products, processes and services. SMEs can use innovation vouchers to commission knowledge institutes to address appropriate research issues.

Box 3.5. Knowledge Voucher Programme in the Netherlands (continued)

Vouchers are available in two sizes: small and large. A small voucher is worth EUR 2 500 and a large voucher is worth up to EUR 7 500. To use a large voucher, an SME must make a contribution of at least one third of the total project cost; the government will then contribute up to EUR 5 000.

Vouchers are available for two types of projects: knowledge transfer projects and patent applications. Large knowledge transfer vouchers may be bundled: up to ten enterprises may collectively use vouchers which have been awarded to them individually to cover the cost of a major knowledge transfer project.

Vouchers may be used for projects involving the transfer of knowledge from public knowledge institutes and various private knowledge institutes. A knowledge transfer project involves the transfer of knowledge that is new to the receiving SME. The knowledge is used by the enterprise to modernise a product, production process or service. All projects must benefit the Dutch economy. No individual enterprise is entitled to receive more than one small voucher for a knowledge transfer project at any time and more than one large voucher per year. The bundling of patent application vouchers is not permitted.

Source: Roper S., Innovation Voucher Schemes, "A Review of Local Economic and Employment Development Policy Approaches in OECD Countries: Policy Audits (Part I), pp. 212-222, OECD, Paris.

Collaborative research programmes are also a viable option to bring together tertiary education and industry. Collaborative research is traditionally set up to facilitate knowledge flow between academic research and company R&D staff. They have a limited duration (around five years), tend to focus on precompetitive research (*i.e.* research that goes up to the level of a prototype), and normally take the form of a concrete centre where researchers from the two different settings work together. Partnerships are selected through a call for tender for joint applications of R&D and university labs. Selection criteria include quality of the proponents of the scientific and industrial R&D as well as the projected contribution of the partnership to regional competitiveness. In considering implementation, policy makers need to ensure that they have some leverage over universities, which may involve the potential to attract funding, research perspectives and career incentives. The establishment of similar partnerships would therefore partly be a question of adjusting research and funding incentives currently available in the Veracruz university system.

Knowledge transfer programmes based on people mobility between tertiary education institutions and industry in Veracruz could help improve the absorptive capacity of the SME-based economy. An important channel of knowledge exchange is internships that provide students with an entry point into the workforce. The Universidad Veracruzana's enterprise brigades (*brigadas en empresas*) is an interesting initiative which expose students to their first labour market experiences, but it is not clear to what extent this benefits firms, given that undergraduate students are often not yet well-placed for providing business advice and consulting. In addition, another people-based mobility scheme, the mentoring programme at Anahuac University at Xalapa (UAX), is designed to provide students the opportunity of work in a company with the supervision of one of the company's leaders. More than 500 students have participated in the programme since its beginning. Students are required to work on a full-time basis during a 5-week period (see Chapter 2, Box 2.8.).

These programmes have helped change mindsets within the academia and business and created a climate conducive to the emergence of joint projects. However, the programmes are small in scale and limited to the individual institutions, selected fields and undergraduate students. It would be advisable to expand the existing programmes into graduate and PhD levels and, in the case of the Universidad Veracruzana, also beyond management and accounting departments to encompass applied-science departments. Firms would benefit not only from the exposure to accounting or marketing, but also from expertise in more technical fields such as engineering and information/communication technologies. These programmes should consider the different time frames of students and business owners to allow for flexibility and increase the potential time for interaction between students and business owners.

In developing these programmes, lessons could be learnt from the experience of the small business development in North Carolina that brings long-term counselling and training courses for small business owners throughout the State of North Carolina and uses university business faculty and students as coaches. This innovative programme combines the needs of the small and medium-sized enterprises with the needs of the universities to provide systematic and well tutored work-based learning experience to students (see Box 3.6.).

Box 3.6. Small business development in North Carolina

In North Carolina, US, the federally funded small business assistance programme is a University of North Carolina system-wide programme managed by NC State. Its network of 17 Small Business Development and Technology Centres is based mostly at business schools in other public colleges across the state, providing training courses and counselling for small business owners.

The small business centres are focused on special expertise in technology assistance, in helping small business find local sources of capital and in providing lengthy (20 to 30 hours) and intensive one-on-one counselling programmes for small business owners. The programme is able to offer intensive consulting services because it relies on faculty and business students, about 650 a year. They provide valuable service and the experience adds value to their education. The programme counts 110 000 counselling clients and 85 000 attendees at training programmes since 1984, with the clients creating 25 000 jobs and growing sales and jobs at more than three times the state average. Separate training programmes are in place to help small investors in the state to understand how to set up, operate and succeed with local “angel capital” networks and to train small business owners how to find investors, understand their expectations and meet their needs.

Source: Schaffer, D.F. and D. J. Wright (2010), “A New paradigm for Economic Development, in Tertiary education”, The Nelson A. Rockefeller Institute of Government, New York.

There may also be a need to consider the establishment of state-level specific programmes to link the university post-graduates with the local industry. In the United Kingdom, the Knowledge Transfer Partnership Scheme has been running successfully (previously as Teaching Company Schemes) since the 1970s. Knowledge Transfer Partnerships improve the competitiveness of the companies through introduction of some form of innovation or new technology, while an additional benefit is usually the recruitment of the postgraduate associate; around 75% of associates in projects lasting from one to three years are offered jobs in the company (see Box 3.7.).

Box 3.7. UK Knowledge Transfer Partnerships

The Knowledge Transfer Partnership programme in the United Kingdom was launched in the 1970s as the Teaching Company Scheme, and was designed specifically to foster close collaborative partnerships between universities and companies with an explicit focus on the transfer of knowledge into company practice rather than supporting research in universities. The main focus is on improving the competitiveness of the industrial partner, through the work of post-graduate “associate” working in the company with supervision from the academic partner.

The scheme is partly funded by the companies involved and partly by a public organisation such as the Technology Strategy Board or a Research Council, with more advantageous terms available for small and medium-sized enterprises (SMEs). Typically an SME would pay around GBP 20 000 per year for involvement. The projects are usually 2 years in duration and the postgraduate associate is employed to work in the company during this period on a pre-defined project. The associate is paid a salary and in some cases is registered for a higher degree (usually devoting 10% of their working time to professional development), and forms the linkage between the company and the supervising academic in a university or research organisation. The academic partner is compensated for some of the time of the supervisor and for university overheads (KTP, 2010).

The primary outcome of the project is usually the implementation of some form of innovation or technology in the company, although an additional benefit is usually the recruitment of the associate and around 75% of associates in projects lasting 1-3 years are offered jobs in the company. The 2008/09 annual report for the scheme reported 977 active projects and estimated the benefits to UK business would be over 6 500 staff trained, 1 119 new jobs created and an increase in pre-tax profits of GBP 126 million (TSB, 2009).

Source: OECD (2010a), *The State of Victoria, Australia*, Reviews of Tertiary education in Regional and City Development, OECD, Paris.

3.5 New business formation

New business formation faces challenges in Mexico predominantly due to bureaucratic constraints. The federal government has acknowledged the constraints and launched programmes to bridge the gap. The Mexican SME Policy includes programmes that encourage collaboration and innovation. The Ministry of Economy, through the Fondo PYME (SME Fund), drives

the engagement of tertiary education institutions with their SMEs in the region. For example, the Programme for Innovation and Technology Development funds business accelerators and innovation laboratories that in many cases are housed in tertiary education institutions. The incubators of the National System of Incubators are also often run by tertiary education institutions (OECD, 2009a; 2009b). The Mexican Government along with Santander Bank rewards tertiary education institutions for their university-enterprise collaboration on a competitive basis.

Following the US model, Small Business Development Centers have been created in Mexico. The SBDCs link tertiary education institutions and different levels of government to serve micro, small, and medium-sized enterprises (SMEs). Started in 2001 with the support of USAID Mexico, the Mexican Association of Small Business Development Centres (AMCDPE) was created to build capacity among Mexican tertiary education institutions to fulfil their role as actors within Mexico's economic development infrastructure. The Universidad Veracruzana has been active in this collaboration, leading the association. Today, it is a network of nearly 90 SBDCs that are located across the country and hence have a regional and local focus. Currently there are 14 SBDCs in Veracruz belonging to this network, 11 out of the 14 SBDCs are directly linked to a tertiary education institution.

Tertiary education institutions in Veracruz have taken steps to establish business incubators. The Incuba centre of the Universidad Veracruzana's and Veracruz's Business Incubators Network of the technological institutes are the most prominent examples of incubation activities in Veracruz (see Box 3.8.).

Box 3.8. Business incubators in Veracruz: Strengthening formal economy of the state

Universidad Veracruzana's *Incuba* centre

Started in 2005, *Incuba* is the Universidad Veracruzana's centre for business incubation and development, which has offices on the five campuses. *Incuba* follows the business model of the US-based Small Business Development Centres (SBDCs). The university has lead the Mexican Association of SBDCs (54 university members), which serves as a focal point for promotion, advocacy and lobbying. A memorandum of understanding that formally links Mexican centres with US-based SBDCs for mentoring and trade development is in place. In particular, a web-based trade platform to link 750 000 small business clients of the US SBDCs with their Mexican counterparts has recently been established to increase bilateral trade opportunities, market research and technology development on both sides of the border.

Box 3.8. Business incubators in Veracruz: Strengthening formal economy of the state (continued)

The aim is to create a network of over 100 Mexican SBDCs, and the Universidad Veracruzana is responsible for further accrediting the new centres and tracking and evaluating the offered business services.

Incuba provides services in the areas of technical consulting, technological innovation, capacity building, supply chain development, international trade and productive diversification with regard to both business incubation and business development of existing firms. The “business incubation” unit follows a three-step approach: *i*) business idea assessment; *ii*) a 20-hour workshop on business planning, basic administration, accounting, tax compliance, credit access and public procurement and *iii*) a one-year follow-up of the business plan implementation. In 2008, 80 businesses have gone through this process. The “business consulting” unit follows a six-stage approach. In 2008, 42 micro firms were served and 372 jobs were reportedly preserved. Most of the firms using these services are in the manufacturing sector (23 firms), with the others equally distributed between the trade and service sectors.

The Veracruz's Business Incubators Network

The Veracruz's Business Incubators Network (REINCUVER) started in 2005 and currently consists of 34 incubation centres across the state (REINCUVER, 2010). They have attracted USD 1.2 million and benefited around 230 firms and generated nearly 1 500 jobs. At a cost of USD 931 per job, this programme compares well with traditional public job-generation programmes. REINCUVER is largely composed of technological institutes' business incubators (18 out of 34), where the majority of tenants are experienced business experts and thus the programme can also be a way to formalise nascent economic activities. There is no preference for alumni or faculty on the part of institutions. The consulting services offered as part of the incubation programme are provided by professors and external consultants, and most of the financial support comes from the state secretary of the economy.

The Incuba centre of the Universidad Veracruzana's and Veracruz's Business Incubators Network of the technological institutes are commendable initiatives. While incubators favour individuals with higher skills, public support for jobs created in incubators compares favourably with support for other public job creation programmes. In the case of the Universidad Veracruzana the wide number of national and international links is also an asset that the university and the state should take better advantage of. Compliance with the US-based Small Business Development

Centre (SBDC) model is not a guarantee of success but it depends on how the model is implemented. Currently, the existing incubators support a heterogeneous mix of firms which implies that the goals and objectives of the incubators and the selection criteria have not been clearly defined.

Furthermore, business incubation programmes in Veracruz call for reconsideration in terms of four aspects:

- **Sector focus:** According to the OECD definition, “incubators typically seek to provide workspace, often on preferential and flexible terms, for a specific industry or type of firm, while concentrating spatially the supply of utilities, services, facilities and equipment” (OECD, 1999). In the case of Veracruz none of the incubators in the university and technological institutes’ system have a special sector focus.
- **Displacement effects:** When supporting firms in traditional sectors, the risk of displacement effects and the extent to which this support results in added value for the economy should be taken into consideration. Supporting firms in an already strong sector such as agro-industry is likely to result in unfair competition.
- **Links with the local economy:** Incubators do not need to provide all services in-house, but can also subsidise the use of external services. This may stimulate the emergence of a market for private business development services (BDS) and generate lower displacement effects of current BDS operators.
- **Operational aspects:** In the case of the Universidad Veracruzana model, the initial workshop of 20 hours on basic management principles is appropriate, but courses on more specific subjects should be available throughout the year of incubation. Entrepreneurship is a learning-by-doing process rather than something that one first learns and then implements. Similarly, gradual facing out of the tenancy would bring better results than strict limitation to 12 months.

If the provision of business support services is seen as the principal function of an incubator, as appears to be the case in Veracruz, then the basis for public investment should be an understanding that a competitive market will undersupply necessary services. Even so, public intervention in the direct supply of services is not always the best and most cost-effective solution. Links with the local Business Development Services (BDS) community are important and incubators can work as referral points, signposting (and eventually subsidising) the range of private enterprise

support services available locally. A similar arrangement would still help the tenant firms, but without displacing current private BDS providers.

The Universidad Veracruzana does not have a technology and innovation policy. There is neither a technology transfer office nor a technology incubator. This is in stark contrast for example with the situation in the United States where one-third of incubators have a technology focus. Technology-based incubators are often closely linked to universities and hosted in university premises or in science parks in the vicinity. They can be used to launch new high value-added sectors as well as to generate a university spin-off policy, which is also not yet an ambition of the Universidad Veracruzana. Students could be mobilised through appropriate programmes that are aimed at identifying technologies developed by the university that can be successfully put on the market and lead to new business formation (see Box 3.9.).

Box 3.9. The Technology Ventures programme at the University of Illinois at Chicago

The Technology Ventures programme at the University of Illinois at Chicago (UIC TVP) makes use of graduate students to launch businesses that commercialise promising technologies. Chicago lacks a vibrant community of technology SMEs looking for new technologies and serial entrepreneurs. Although the Chicago investment community has shown keen interest in high tech spin-offs from the HE system, few have been established. At the same time, investors are often not able to see the potential in raw technologies. UIC TVP was established to provide a mechanism to bring high-potential technologies to the attention of investors. Teams of graduate students (including MBA, MD, pharmacy and engineering) select technologies from amongst the hundreds owned by the university. They conduct market research, draft business plans on how to commercialise those technologies, negotiate with the faculty inventor to join their team and approach investors.

In its first year (2005-06), UIC TVP launched two start-ups. One was a biotechnology firm launched to commercialise a revolutionary cancer treatment. The other firm was seeking to bring to market an orthodontic device that reduced the time required for correcting orthodontic malocclusion (crooked teeth). During its second year, UIC TVP launched four more high-potential, high-tech firms, including a medical device for non-invasive cornea reshaping, an umbilical cord stem cell technology, a vascular imaging technology and a micro-fluidic device. Without UIC TVP, these technologies would have remained "on the shelf", out of sight of potential investors. UIC TVP has received national attention from the media, HEIs and investment groups.

Box 3.9. The Technology Ventures programme at the University of Illinois at Chicago (continued)

Reasons for the success of UIC TVP include: *i)* hundreds of technologies owned by the university; *ii)* university's expertise, resources and a solid reputation in life sciences; *iii)* university's inventions, links to established biotech firms and recognition by potential investors; *iv)* support from university administration; *v)* student teams, that had an option to license the technology, giving them an incentive to ensure a successful venture and *vi)* requirement to involve the faculty inventor in return for an equity stake in the business, providing incentives for the inventor to help the company to succeed.

The UIC TVP has faced obstacles such as: *i)* lack of capacity of local investors to evaluate business plans and risk aversion and reluctance to invest in businesses launched through the UIC; *ii)* lack of perceived legitimacy of student-owned businesses in the media and business/investment communities; *iii)* challenge to convince stakeholders that students were prepared to step aside when professional managers were successfully recruited; and *iv)* heavy work load on students.

Source: OECD (2007), *Entrepreneurship Environment and Policies: Exploiting the Science and Technology Base in the Region of Halle*, LEED Discussion Paper, OECD, Paris.

The Hothouse Business Incubator (Box 3.10) at the Dublin Institute of Technology provides useful insights into policy and operational issues for tertiary education institutions, policy makers and other stakeholders interested in the promotion of new technology enterprises. Key insights include:

- Develop the incubator model, when possible, within the framework of a national policy on campus incubators and campus enterprise programmes. This policy should establish objectives and robust evaluation procedures, based on effective international practices.
- Develop and focus on standard procedures e.g. training, counselling, and networking, client services as well as human interaction and shared experiences cultivated among participating companies.
- Connect campus centres with national and local development agencies and a network of partners in the public and private sectors.
- Use competent mentors, counsellors and other advisors: management techniques need to be delivered in a practical way, preferably by people with business experience.

- Provide good quality office/administrative facilities, technology guidance (e.g. software licensing) and funding support companies.

Box 3.10. The Hothouse Business Incubator, Dublin, Ireland

The Hothouse business incubator project was launched in 2001 by the Project Development Centre (PDC) at the Dublin Institute of Technology (DIT, Ireland's third largest tertiary education institution, with over 21 000 students). Its mission is to stimulate growth by helping entrepreneurs, particularly for technology-oriented and knowledge-based businesses. The year-long programme provides: *i)* a base in the dedicated incubator with broadband and support/office facilities to conduct business and with on-site training and regular coaching from the PDC team; *ii)* training workshops to improve capabilities in key business areas and all participants receive a training grant of EUR 6 600; *iii)* mentoring by experienced business people; *iv)* access to a network of experts and entrepreneurs, including R&D expertise and commercial evaluation help; *v)* help in raising investment finance; *vi)* market research clinics, *vii)* technical consultancy on intellectual property rights issues, patenting, and licensing and *viii)* business plan evaluation, administered by two experts twice a year.

Selected participants (based on prospects for growth and exports) receive 50% of their previous year's salary, subject to a maximum of EUR 38 000. Funding is provided by the Department of Education and the national development agency, Enterprise Ireland. The total funding allocated for 2002-03 was approximately EUR 1.5 million, with an average cost per participant of slightly more than EUR 17 000. Private sector representatives contribute time and support to the programme at their own expense.

Source: Potter, J and M. Marchese (eds.), 2010, A Review of Local Economic and Employment Development Policy Approaches in OECD Countries: Policy Audits, OECD/LEED Working Paper N. 2010/06.

Improving connectivity and mobility

Connectivity is a major challenge for the development of Veracruz. The geographical, topographical and ethnic situation presents a number of challenges for providing access to transport infrastructure, communications and public services, especially in peripheral regions. Connections between urban centres and rural areas are crucial for greater development and further improvements in infrastructure are needed to connect peripheral regions and rural areas. Intra-regional disparities within the state in access to telecommunications remain significant and pose a challenge for regional development in terms of widening access to education in remote areas,

improving teleworking opportunities and dissemination of innovation for in small and medium-sized enterprises. While no robust data was available about the inequalities in access to communication, they are likely to broadly correspond to disparities in GDP per capita. Improving access to telecommunications represents a potential source of growth and should be favoured.

The Universidad Veracruzana has made commendable progress in linking its five campuses through e-networking that facilitate real time meetings and conferences. To what extent this capacity is used for regional development purposes is, however, unclear. Furthermore, COVECyT has supported the development of state-wide communication network to establish a learning platform.

In international context, improvements in connectivity have received priority attention, for example by the Regional Government of Andalusia in Spain. Systematic investments in high speed trains and high-speed internet improved mobility and connectivity in the region which has the second lowest GDP in Spain. In addition, the regional government invested in the developing broadband network for the Andalusian tertiary education system and online learning platform (see Box 3.11.).

Box 3.11. Enhancing connectivity in Andalusia

During the recent decades, the Regional Government of Andalusia has systematically improved the connectivity and mobility by developing the railroad network and increasing high speed trains. It has also made considerable investments in improving intraregional connectivity, now providing the region's rural areas with adequate infrastructure and services.

In 2001, the regional government launched a plan of strategic initiatives for the development of the information society. One of its principal milestones was the Guadalinfo programme, started in 2002, aiming to create a network of public broadband internet centres. By the end of 2006, altogether 637 centres had been created, one in each town of less than 10 000 inhabitants in Andalusia, with a permanent local "facilitator". The current phase within the Information Society Plan for Andalusia aims to extend the network of centres to the fringe areas in these municipalities. This Information Society Plan for Andalusia (2007-10) is one of the major components of the Andalusian Modernisation and Innovation Plan (PIMA).

Box 3.11. Enhancing connectivity in Andalusia (continued)

Availability of high-speed internet in rural areas is crucial for dissemination of innovation in small and medium-sized enterprises. The attention given to ICTs in Andalusia provides its rural firms with the required access and services. The network of technology centres in Andalusia (RETA) provides training and support to promote their use by small firms.

The Regional Government of Andalusia has also made considerable investments to develop broadband networks in the Andalusian University system. Online learning platform pools the e-learning provision of ten universities in Andalusia and diversifies the available teaching offered in the region which is characterised by long distances and a lack of student mobility.

Source: OECD (2010b), Reviews of Higher Education in Regional and City Development: Andalusia, Spain, OECD, Paris, <http://publications.oecd.org/acrobatebook/8910121E.PDF>

3.6 Engaging in challenge-driven research and innovation

Veracruz is a region of high rates of poverty and illiteracy, low skills, intra-regional disparities and environmental emergencies. Social and technological innovations are necessary to address these challenges. Tertiary education institutions in Veracruz can contribute to developing collaborative strategies that can respond to the social, cultural and environmental challenges. These contributions are particularly valuable in the development of state-wide challenge-driven multidisciplinary research and innovation efforts in order to balance the current technology focus of the innovation concept. The Universidad Veracruzana has addressed these challenges mainly through social service, by mobilising its students and faculty, but is also increasingly integrating R&D and innovation into social service. This approach has already revealed commercial potential.

Veracruz has the third largest indigenous population in Mexico, who have lower earnings and educational levels than the non-indigenous population and face barriers in accessing formal education and the labour market. At the same time however, the indigenous populations have traditional skills and industries with commercial potential. The development of these industries could enhance the skills levels and create jobs. The commercial potential exists for example in the traditional medicine offered by healers in the indigenous communities. The Universidad Veracruzana has a support group of students and teachers to develop traditional medicine (see Box 3.12.).

Box 3.12. Universidad Veracruzana: preserving traditional medicine

In 1995, the Universidad Veracruzana started a Regional Group to Support the Traditional Indigenous Medicine (GRAMIT, in its Spanish acronym) with the support of several government agencies. The group was established as a joint effort of the Universidad Veracruzana in partnership with the Organisation of Indigenous Traditional Healers (OMIT) of central Veracruz and the Mexican Social Security Institute, with the aim of developing traditional medicine in the State of Veracruz.

GRAMIT supports around 300 indigenous healers in providing technical support to develop specific equipment and procedures, including the: *i*) development of a regional catalogue of healing plants; *ii*) methods to ensure quality assurance of herbal remedies; *iii*) registry of herbal remedies at the Federal Ministry of Health; *iv*) guidelines and support in the establishment of healing plants' gardens; *v*) establishment of commercialisation protocols for herbal remedies and *vi*) small-scale manufacturing of herbal remedies at the Herbal Products Regional Lab in Ixhuatlancillo, Veracruz.

The participation of students and academic staff from several disciplines, (e.g. biology, chemistry, agronomy) in GRAMIT has brought benefits in terms of knowledge acquisition and dissemination. The group has released publications on alternative therapy methods used by indigenous healers as well as the identification of social, cultural and economical factors influencing dwellers' health in rural communities. An important contribution of GRAMIT is the development of a set of hygienic standards that have been followed by the traditional healers in the preparation of remedies.

International examples in this area include the International Stress Prevention Centre in Israel (see Chapter 2, Box 2.11.) and the University of Texas at El Paso's Center for Environmental Resource Management (CERM) (see Box 3.13.). These examples show the potential of combining community outreach into training and challenge-driven research that can generate improvements in life quality and low tech innovations.

The University of Texas at El Paso (UTEP) is committed to environmental stewardship, energy efficiency and sustainability. Its Centre for Inland Desalination Systems (CIDS) is a centre of excellence for the total spectrum of inland desalination topics. It's Pan-American Center for Earth and Environmental Studies (PACES), established in the late 1990s, conducts basic and applied research and serves as a repository for information in geological, geophysical, ecological and environmental processes and changes in land usage in the region. The university's Centre

for Environmental Resource Management (CERM) collaborates on a long term basis with the City of El Paso and reaches out to low income neighbourhoods to provide energy efficient technologies and water disinfection technologies (see Box 3.13.).

Box 3.13 UTEP Center for Environmental Resource Management (CERM)

The Center for Environmental Resource Management (CERM) focuses the University of Texas at El Paso's research on the environmental problems that threaten the health, safety, well-being and economic development of the southwest border region of the United States. These problems include water quality & availability, air quality, hazardous waste management and remediation, energy, desert ecosystem protection, environmental health, environmental justice and sustainability. CERM projects include:

- The development of the Rio Bosque Wetlands Park through restoring 372 acres (1.5 km²) adjacent to the Rio Grande to its original habitat based on a 30-year agreement with the City of El Paso.
- PATCH (Partnership for Advanced Technology in Colonia Housing): Assistance to low-income communities and neighbourhoods in applying Energy Star and other energy efficient technologies in affordable housing.
- *Agua para Beber* (Drinking Water): A community-based, train-the-trainer programme that teaches appropriate water disinfection technology and home sanitation and healthy home environments. This programme uses *promotoras*, community advocates to educate residents of low-income neighbourhoods to recognise environmental risks in their homes and to use environmentally-benign products. The Agua para Beber project won the Texas Environmental Excellence Award in 2007.

Source: OECD (2010c), Reviews of Higher Education in Regional and City Development. The Paso del Norte Region, Mexico-United States, OECD, Paris, www.oecd.org/dataoecd/17/61/45820961.pdf

Conclusions and recommendations

Veracruz has features of both an old industrial and peripheral region, dominated by small and medium-sized enterprises (SMEs) and branch plants that are externally controlled. The key challenge is to foster the renewal of old sectors and innovation activities in the related industries and to upgrade the knowledge base. Policy should focus on industrial and technological diversification and on the reorganisation of existing firms, networks and institutions as well as formation of new enterprises. Policy measures should target small and medium-sized enterprises (SMEs) and their innovation weaknesses as well as improving innovation attitudes. Establishing mobility schemes, for example innovation assistants for SMEs and improving medium-level skill provision are also necessary (see Table A.3.1.). In order to formulate and implement policy intervention and initiatives, policy makers should have robust data about the specificities of the regional innovation system in Veracruz and the factors undermining its development potential.

Due to globalisation, the national and international competitiveness of Veracruz now heavily depends on its innovation capacity. Innovation creates conditions for producing new products and processes with value-added by means of technological process and organisational arrangements. In this sense, innovation is determined to some extent by a region's capability to generate knowledge and technology or by its capacity to adopt available technology. This is a specific task for the universities and other tertiary education institutions, since they are centres of knowledge transmission and production, as well as providers of science and engineering graduates. Currently the regional innovation system in Veracruz is fragmented with limited contribution from universities and other tertiary institutions. The system suffers from the lack of a collaborative culture among the tertiary education institutions and also with firms. There is also a lack of effective communication about both the potential services of tertiary education institutions and the research conducted by them. There is a focus on a limited number of research areas, a low level of investment into research and development and a lack of data on R&D expenditure and innovation outcomes.

The OECD review team recommends the following measures are taken in promoting innovation development:

- The federal government should improve the evidence base of the RDI performance by collecting robust data about the state-level performance. This data should be made available on-line in order to develop strategic intelligence at the sub-national level, to facilitate

comparisons between the states and regions abroad, and to provide a catalyst for shared learning. The European Innovation Scoreboard could be a source of inspiration in this context.⁸ The federal government could establish guidelines that would help the states to refine their statistical instruments. Data should be improved in terms of human capital development (*e.g.* population with tertiary education, participation in lifelong learning, youth education attainment level), innovation throughputs (*e.g.* patents, spinoffs and start-ups) as well as output indicators.

- The state government in collaboration with the leading tertiary education institutions and the business sector should develop a clear strategy for regional development, innovation and growth. Such a strategy should be based existing strengths and develop related sectors and technologies. The strategy should be backed with adequate level of investment in human resources and infrastructure. It should draw on a diagnosis that identifies the key driving sectors of the economy. The government should ensure that research on clusters and demands of industry extend into service sector and include clusters such as tourism. Clusters should be conceptualised as cutting across the manufacturing-service divide – for example, agribusiness clusters usually connect with tourism and manufacturing innovations incorporate service components.
- Tertiary education institutions in Veracruz should increase their efforts to participate in international collaborations projects in the field of technology with European and Asian countries which have a strong tradition in technological education. To achieve this goal, it is recommended that an international office at state government level (Veracruz Ministry of Education) is established to promote and co-ordinate international collaboration projects in the higher education sector.
- The state government should encourage more systematic and institutional collaboration between tertiary education institutions and local firms. This collaboration should focus on areas where Veracruz has a real or potential comparative advantage; for example, chemistry and the plastic sector due to the presence of the local oil industry, biotechnologies for the pharmaceutical sector, rather than on a narrow sector specialisation. Technologies with cross-sector fertilisation potential should be promoted. Universities should work to ensure that local firms are aware of the benefits of hiring graduates.

- The state government should encourage collaboration between the tertiary education institutions and local small and medium-sized enterprises (SMEs). Policy tools include people-based mobility schemes, such as the Knowledge Transfer Partnership in UK, that improve the absorptive capacity of local enterprises and support for the forum role of tertiary education institutions to reinforce the regional engagement channels. A relatively low-cost policy measure that have been implemented in a number of countries, for example the Netherlands, the UK and Ireland, is innovation vouchers that expose firms to innovation activities and stimulate a market for innovation. They are small-scale lump sums that firms receive to undertake simple innovative projects. Rules and procedures should be kept as simple as possible and the whole administration process should be managed at the state level, preferably by COVECyT, to guarantee faster examination and approval. Alternatively, the system could be administered directly by a university, which could, however, raise potential conflicts of interest if the university is also an eligible “supplier” of innovation. At the operational level, innovation vouchers can be tweaked depending on specific needs and objectives. For instance, they can focus on specific sectors or technologies or business-to-business collaboration by only allowing applications from groups of firms. Different rounds of calls for applications can be organised to meet different goals and needs.
- Tertiary education institutions should establish a range of links with the local business community. Universities should consult more with the local firms to design research programmes and activities that are more strongly aligned with their needs and expectations. Collaborative research programmes could help improve links between the tertiary education and business sectors.
- Tertiary education institutions should clearly identify the goals and objectives of the business incubators before the launch of the incubator in order to have impact on the selection criteria of tenant firms and the evaluation of the programme. Business incubation schemes are economic rather than social tools and the limited evidence suggests that the most positive effect is on firm survival rates and employment generation (the latter applies mainly to technology incubators). A focus on broad sectors would better benefit tenant firms. Tertiary education institutions should also emphasise the element of flexibility in the provision of business support services in incubators to ensure that the tenant firms have access to an integrated array of services, whether available in-house or outside of the incubator. The selection of services provided by an

incubator should depend on the services available in its vicinity. The provision of a full range of support services is not necessary and will unduly add to overhead costs. Likewise, specialised services can be contracted when needed.

- Tertiary education institutions, especially the Universidad Veracruzana should launch technology-based incubators. Technology incubators represent an increasing share of incubators in the world and are often linked directly or indirectly to local universities. Incubators can also be designed without physical facilities, with a focus on the provision of services, with often a stronger emphasis on intellectual property protection and other legal aspects.
- The Universidad Veracruzana should make stronger efforts to improve the links with the local manufacturing sector in order to encourage the introduction of product and process innovations. It should improve its institutional capacity to engage with the local industry by developing a regional development strategy that would encompass technology transfer and innovation as well as new business generation. It should establish a professional technology transfer office that will actively reach out to local business and industry. It should mobilise its existing national and international connections for the benefit of regional development.
- In addition to providing services to various communities, tertiary education institutions should engage in challenge-driven research, using the region and its diverse range of challenges as a “laboratory” for developing research and innovations. Combining community outreach into training and challenge-driven research can generate improvements in life quality and low tech innovations.

Notes

1. It should be noticed that the national average high-tech output is 11.6 against 1.2 in Veracruz.
2. It employs 90 researchers including 75 SNI Researchers working on biodiversity, flora and climate change.
3. The National Institute of Forestry, Agriculture, and Livestock Research (Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias, INIFAP).
4. SNI Researchers are the nationally designated quality researchers by the National Researchers System (*Sistema Nacional de Investigadore, SNI*).
5. Veracruz ranks third for agricultural production in Mexico.
6. SNI (Sistema Nacional de Investigación) is the system that group Mexican researchers who meet some predefined quantity and quality standards about research, publications and teaching.
7. CONACYT (Consejo Nacional de Ciencia y Tecnología) is the National Council for Science and Technology. COVECYT (Consejo Veracruzano de Ciencia y Tecnología) is the equivalent agency in Veracruz.
8. The European Innovation Scoreboard (EIS) is the instrument developed at the initiative of the European Commission, under the Lisbon Strategy, to provide a comparative assessment of the innovation performance of EU Member States. The EIS 2007 includes innovation indicators and trend analyses for the EU27 Member States as well as for Australia, Canada, Croatia, Iceland, Israel, Japan, Norway Turkey, Switzerland, and the United States. Tables with definitions as well as comprehensive data sheets for every country are included in the Annexes. The EIS report and its annexes, accompanying thematic papers (*e.g.* on innovation in services, wider factors influencing innovation performance and on innovation efficiency), interactive tables to view results and the indicators database are available on the public domain at www.proinno-europe.eu/page/european-innovation-scoreboard-2007.

Annex 3.A.1: Innovation and knowledge transfer in Peripheral regions and old industrial regions

The main characteristic of peripheral regions is “organisational thinness”. There is a lack of dynamic clusters, support organisations and strong institutions promoting entrepreneurship and innovation. If there are clusters, they are normally found in traditional industries with limited R&D and innovation activities. The emphasis is on incremental innovation and on process innovations. Although low and medium level qualifications may be readily available, the more specialised qualifications are rare due to a less developed knowledge infrastructure of specialised knowledge suppliers such as universities and research organisations. Networks are weakly developed in particular networks of specialised knowledge suppliers, such as universities and research organisations. The lower level of tertiary education and R&D provision reduces the internal innovation activity in the region and leads to a low absorptive capacity of the local firms. As a consequence, local firms – especially SMEs – have difficulties in accessing knowledge outside of the region which they need for technological upgrading as well as diffusing such knowledge in regional clusters. Technology transfer offices and organisations have been set up by tertiary education institutions – typically universities of applied sciences – or local business organisations but they are often not effective due to the lack of absorptive capacity in the economy. This implies that the knowledge does not reach the local firms (SMEs) or it does not meet their demand well enough, being too sophisticated to support the mode of innovation (producing incremental innovations) applied by the local firms.

Old industrial regions suffer from various forms of “lock-ins” that constrain their development potential and innovation capabilities. They are characterised by overspecialisation in mature industries which has led to a loss of regional competitive advantage and innovation capacity. Innovation activities follow mature technological trajectories and are focused on incremental and process innovations. Process innovations dominate over efforts to introduce radically new products into the market. Old industrialised regions often have a developed and specialised knowledge generation and diffusion system oriented on the traditional industries and technology fields. A supply oriented approach to technology transfer reaches larger firms but fails to reach the smaller ones.

Source: Tödtling, F. and M. Tripl (2005), “One Size Fits All? Towards a Differentiated Regional Innovation Policy Approach”, *Research Policy*, Vol. 34, No. 8, Elsevier, Oxford, pp. 1203-1219.

ANNEX 3.A.2

Table A.3.2.1. Types of regions and innovation policy approaches

Focus	Type of region	
	Peripheral regions (organisational thinness).	Old industrial regions (lock-in).
Strategic orientation of regional economy	Strengthening/upgrading of regional economy.	Renewal of regional economy.
Innovation strategy	Support "catching up learning" (organisation, technology). Improve strategic and innovation capabilities of SMEs.	Support innovation in new fields/trajectories. Support product and process innovation for new markets.
Firms and regional clusters	Strengthen potential clusters in the region. Link firms to clusters outside the region. Attract innovative companies. Support new firm formation.	Support clusters in new/related industries or technologies. Restructure dominant industries. Diversify existing industry. Support new firm formation. Attract cluster-related FDI.
Knowledge providers	Attract branches of national research organisations with relevance to the regional economy.	Set up research organisations and HEIs in new relevant fields.
Education/skills	Build up medium level skills (e.g. technical colleges, engineering schools, management schools). Mobility schemes (e.g. "innovation assistants" for SMEs).	Build up new skills required (technical colleges, HEIs). Attract new skills.
Networks	Link firms to knowledge providers and transfer agencies inside the region and beyond, following a demand-led approach.	Stimulate networking with respect to new industries and technologies on regional, national and international levels.

Source: Modified from Tödtling, F. and M. Trippl (2005), "One Size Fits All? Towards a Differentiated Regional Innovation Policy Approach", *Research Policy*, Vol. 34, No. 8, Elsevier, Oxford, pp. 1203-1219.

Table A.3.2.2 Knowledge transfer mechanisms in the region

Type of approach	Main activities	Challenges
Licensing	Selling of licenses by university agents to use university-owned patents, copyrights and other intellectual property.	Alternative commercialisation options should be considered with capacity to generate not only revenues but also economic development outcomes. Other strategies are required for intellectual property that cannot be legally protected or where tacit knowledge is attached to an innovation.
Spin-offs	Creation of new firms based on knowledge acquired in the university, by university staff, students or external investors.	Numbers of spin-offs often remain at a low level. Taking stakes in spin-off enterprises is riskier than licensing. A choice may have to be made between concentrating resources on a few potentially high-growth spin-offs and spreading resources to support a larger number of spin-offs. Successful spin-off activity requires investing in entrepreneurial skills and attitudes in university staff, students and graduates.
Technology transfer offices (TTOs)	Offices that manage the process of selling university patents and other intellectual property, usually through licenses.	Offices need to be well connected to and respected by academics. Linkages should be built not only with large firm customers but also SMEs. TTOs are likely to function best in HEIs with a large pool of exploitable intellectual property. Need to refocus on supporting industry productivity and innovation.
Technology brokers	People and agencies facilitate relationships among academics, entrepreneurs and support institutions that will help identify commercialisation opportunities and create exploitation partnerships.	Brokers need to audit and monitor intellectual property within the HEI and build relationships going beyond the obvious departments of business and engineering. Brokers need professional profiles with credibility for both academics and business.

Table A.3.2.2 Knowledge transfer mechanisms in the region (continued)

Type of approach	Main activities	Challenges
Science parks	Organisations that aim to increase the wealth of its community by promoting a culture of innovation and the competitiveness of associated businesses and knowledge-based institutions. They manage the flow of knowledge and technology amongst HEIs, R&D institutions, companies and markets; facilitate the creation and growth of innovation-based companies through incubation and spin-off processes; and provide other value-added services and high quality space and facilities.	Since co-location does not necessarily generate knowledge transfer, regular channels for interaction between university staff, graduates and business must be developed. Science parks in smaller universities may not have sufficient knowledge transfer opportunities to attract firms. Location (proximity to services, transport) and connectivity are important in ensuring networking that will add value.
Incubators	Programmes designed to accelerate the development of entrepreneurial companies through a range of business support resources and services. Incubators vary in the way they deliver their services, in their organisational structure and in the types of clients they serve. In many countries, funded by regional or national governments as part of economic development strategy. In the US, most independent, community-based and resourced projects.	Because spin-off numbers can be very low and variable, heavy investments in physical incubators should be avoided. To keep focused on the objective of providing start-up support, a policy to transfer firms to commercial premises as soon as they are ready needs to be developed.

Source: Adapted from Potter, J. (ed) (2008), *Entrepreneurship and Tertiary education*, OECD, Paris.

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Annex I: Review team members

Jaana Puukka, a Finnish national, leads the OECD work on Higher Education and Regional and City Development. She joined the OECD Programme on International Management in Higher Education (IMHE) in 2005 to co-ordinate and manage the first round of OECD Reviews of Higher Education in Regional Development which took place in 2005-07 and embraced 14 regions in 12 countries. She is leading the second round of reviews in 2008-10 which is reaching out to 14 regions and city-regions in 11 countries. She is the co-author and editor of the OECD publication “Higher Education and Regions – Globally Competitive, Locally Engaged” (OECD, 2007). Before joining the OECD, Puukka had experience in higher education and regional development in Finland as a national and local government adviser, programme manager, practitioner and evaluator. She has management experience from both the university and polytechnic sector and has worked in university internationalisation, PR and communication and stakeholder management. In addition, she has experience in the corporate sector in the pharmaceutical industry.

Patrick Dubarle is the former Principal Administrator at the OECD Public Governance and Territorial Development Directorate (GOV). He has co-ordinated and contributed to a number of OECD territorial reviews at the national and regional level and has recently participated in the regional innovation reviews in Italy and Mexico. In 2004-07 he represented GOV in the OECD project on supporting the Contribution of Higher Education Institutions to Regional Development and co-ordinated the review of the Mid-Norwegian region. He is a graduate from the French *Ecole des Mines* and holds a Masters degree in Economics from the University of Paris Sorbonne. He joined the OECD in 1978 as administrator in the Directorate for Science Technology and Industry. He was appointed Secretary of the OECD Working Party on regional development policies in 1992, where he was responsible for country regional policy reviews and horizontal programmes. He has worked with national governments in many OECD countries and has spoken at several international conferences. He is the author of documents on high technology policies and sectoral questions

including space industry, technological change, technology fusion, innovation and higher education in regional development.

Ernesto Flores joined the OECD Programme on Institutional Management in Higher Education (IMHE) in Paris in 2009 for a 15-month secondment to support the OECD review programme Higher Education in Regional and City Development. He holds a master's degree from Monterrey Institute of Technology and Advanced Studies, Mexico. He has worked as a Consultant in the Quality Centre of Monterrey Tech, developing projects in several companies. In 2002, he was invited to collaborate with the Strategic Planning and Regional Development Office of the Executive Office of the President of Mexico where served as planner and consultant in strategic planning for Federal Government offices to align actions with the Mexico's National Development Plan. Since 2004, he has been working at the Sonora Institute of Technology (*Instituto Tecnológico de Sonora*, ITSON) as planning co-ordinator, participating in projects aimed at improving economic and social performance in the region, such as the creation of the Technology Park and the Digital City initiatives. In addition, he led international projects in the field of innovation-based regional development.

Jocelyne Gacel Avila has been in charge of the internationalisation process at University of Guadalajara, Mexico, for more than 20 years, as General Director for Co-operation and Internationalisation. She is a tenured researcher, professor on higher education at postgraduate level. She is a Level II member of the National System of Researches in Mexico (SNI) and considered an expert in internationalisation in Latin America. She has written and co-ordinated twelve books and a large numbers of articles. She has collaborated in research projects with different international organisations, such as the World Bank, the Ford Foundation, the European Commission, the Consortium for North American Collaboration in Higher Education (CONAHEC), the Observatory on Borderless Higher Education, the International Association of Universities, and the Inter- American Higher Education Organization among others. She was a founding member and president of the Mexican Association for International Education (AMPEI) and elected president and vice-president of CONAHEC 2005-2007. She also received the 2006 AMPEI Award for supporting the process of internationalisation of higher education in Mexico, and the Distinction Award of CONAHEC in 2009. Since 2007, she has been representing Mexico on the IMHE/OECD Governing Board and was appointed Vice-President for the period 2010-12.

Marco Marchese joined the OECD in 2007 to work on entrepreneurship policy and evaluation of local economic development

approaches. At the OECD he has recently managed an review of local development policies and strategies for the Welsh Assembly Government, which resulted into four reports, and is working on a number of publications on local entrepreneurship strategies, FDI attraction and local prosperity, and entrepreneurship and innovation. Prior to joining the OECD, he worked for the ILO and UNIDO on business clusters and for the Italian Prime Minister's Office focusing on the informal economy in the south of the country. He has also been a Fulbright visiting scholar at MIT, where he carried out an analysis of the local biotech cluster. He holds a MSc in development economics from the University of Rome "Tor Vergata".

Juan Carlos Navarro joined the Inter-American Development Bank (IADB) in 1997 and has contributed to the development of technical assistance activities and lending programs in the fields of education, science, technology and innovation in about 20 countries in the region. His work currently focuses on scientific and technological development issues in Latin America and the Caribbean within the Science and Technology Division of the IADB. He has regularly conducted research and published on issues regarding higher education policy, management, financing; science, technology and innovation policy and management; educational applications of technology; quality assurance in education, K-12; public-private partnerships in education and innovation; human resource development in technical and scientific fields and political economy of education policy. He is currently co-coordinating a comparative research project on the impact of innovation on productivity in Latin America, and editing a book on education quality. He holds an MPP from Georgetown University and completed doctoral studies in political science at the Central University, Caracas. Before joining the IDB he was a professor at the Instituto de Estudios Superiores de Administración (IESA) in Venezuela, his home country, and at the Catholic University Andrés Bello (UCAB), as well as a Ford Foundation-LASPAU Visiting Scholar on Latin American Higher Education at Harvard University in 1995.

Annex II: Programme of the review visit

Sunday 11 October – Veracruz City

11:30-13:30	Visit to the "Casa de la Universidad" at Atlahuilco
18:00-20:00	OECD Review Team internal meeting

Monday 12 October – Veracruz City

09:00-10:30	Representatives of Education and Science Sector
10:30-11:45	Representatives of Productive Sector
12:00-13:30	Representatives of Social Sector
15:30-17:30	Representatives of Public Sector

Tuesday 13 October – Córdoba and Orizaba

11:00-12:00	Representatives of Education and Science Sector
12:00-13:00	Representatives of Productive Sector
15:00-16:00	Representatives of Social Sector
16:00-17:00	Representatives of Public Sector

Wednesday 14 October – Poza Rica and Coatzacoalcos

11:00-12:00	Representatives of Education and Science Sector (Poza Rica)	Representatives of Education and Science Sector (Coatzacoalcos)
12:00-13:00	Representatives of Productive Sector (Poza Rica)	Representatives of Productive Sector (Coatzacoalcos)
15:00-16:00	Representatives of Social Sector (Poza Rica)	Representatives of Social Sector (Coatzacoalcos)

16:00-17:00	Representatives of Public Sector (Poza Rica)	Representatives of Public Sector (Coatzacoalcos)
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Thursday 15 October – Xalapa

11:00-12:00	Representatives of Productive Sector
12:00-13:00	Representatives of Education and Science Sector
16:00-17:00	Representatives of Public Sector

Friday 16 October

09:00-13:00	OECD Review Team internal meeting
15:00-17:00	Feedback session to the Regional Steering Committee

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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Higher Education in Regional and City Development

State of Veracruz, Mexico

With a population of over 7 million Veracruz is the third most populous state in Mexico. Veracruz features a traditional and resource-based economy, low skilled population and high poverty rates.

How can Veracruz transform itself from a lagging and under-performing region into a centre of knowledge and innovation? How can the universities improve the relevance and quality of their teaching and research? How can the pathways between technological institutes and universities be improved? How can Veracruz capitalise on the ongoing university social service programmes to create a more comprehensive approach to regional development?

This publication explores a range of helpful policy measures and institutional reforms to mobilise higher education for regional development. It is part of the series of the OECD reviews of Higher Education in Regional and City Development. These reviews help mobilise higher education institutions for economic, social and cultural development of cities and regions. They analyse how the higher education system impacts upon regional and local development and bring together universities, other higher education institutions and public and private agencies to identify strategic goals and to work towards them.

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